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FRANK A. TAYLOR
Director, United States National Museum

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*Errata: On p. 105 transpose *Tinea pellionella* from family Oinophiliidae to family Tineidae, following *Tinea pallescentella.*

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MICROLEPIDOPTERA OF JUAN FERNANDEZ ISLANDS

By J. F. Gates Clarke

Chairman, Department of Entomology

Introduction

It has been my privilege and pleasure to study the Microlepidoptera collected in the Juan Fernandez Islands in 1951, 1952, and 1955 by Dr. Guillermo Kuschel, Centro de Investigationes Zoologicas, University of Chile, Santiago, and to him my thanks are due for this opportunity.

Through the courtesy of Dr. Kuschel I have been permitted to deposit the types of all the new species in the collection of the U.S. National Museum, Smithsonian Institution. Paratypes of some of the species, where series permitted, are also in the Museum, while others are distributed in the Natural History Museum and the University of Chile in Santiago.

My sincere thanks are due Dr. Lars Brundin, Naturhistoriska Riksmuseum, Stockholm, for his generous permission to study Aurivillius' types deposited in that institution. To Mr. John D. Bradley, Department of Entomology, British Museum (Natural History), I am also grateful for his help received on many occasions.

The drawings for this paper were made by Mr. Arthur D. Cushman, staff artist of the Entomology Research Division, U.S. Department of Agriculture; Mrs. Patricia Hogue; Mrs. Caroline Lutz, staff artist, Department of Zoology, Smithsonian Institution; and by myself.

The collections made by Dr. Kuschel are of more than usual interest because they are the first of any size from the islands and are the first to provide any tangible information about possible origins of the fauna.

The first Microlepidopteron to be described from the islands was *Pionea fumipennis* (Warren), (1892); although the type specimens are labeled properly, Warren mistakenly gave the locality as "California." In 1896 Hampson described *Crambus fernandesellus* but it was not until 1922, with the publication of Skottsberg's classic work, that more collections were recorded. In this publication Aurivillius described *Fernandocrambus brunneus, F. fuscus, F. bäckströmi, Juania annulata, Eulia robinsoni, E. griseiceps, E. striolana* and *Crocidosema* (?) *insulana* and recorded the continental *Scoparia ragonotii*. In the same work Meyrick described *Depressaria relegata, Apothetoeca synaphrista* and recognized *Endrosis sarcitrella* (recorded as *Endrosis lactella*). Clarke described *Nanodacna ancora* in 1964.

This brought the total number of species known from the islands to 15. In this paper 41 species are described as new to science; 14, previously described, are recorded from the islands for the first time; two species (two families) are recorded but the species are not named; and one species is synonymized, thus bringing the total of known species to 71.

Species Previously Recorded

Pionea fumipennis (Warren)
Oeobia ragonotii (Butler)
Juania annulata Aurivillius
Fernandocrambus bäckströmi Aurivillius
  fuscus Aurivillius
  brunneus Aurivillius
Crambus fernandesellus Hampson
Proeulia griseiceps (Aurivillius) (=*striolana*)
  robinsoni (Aurivillius)
Parasuleima insulana (Aurivillius)
Martyrhilda relegata (Meyrick)
Endrosis sarcitrella (Linnaeus)
Apothetoeca synaphrista Meyrick
Nanodacna ancora Clarke

Species Newly Recorded

Elasmopalpus angustellus Blanchard
Nomophila noctuella (Denis & Schiffermüller)
Platyptilia epidelta Meyrick
Stenoptilia partiseca Meyrick
Gnorimoschema operculella (Zeller)
  absoluta (Meyrick)
Bedellia somnulentella (Zeller)
Monopis crocicapitella (Clemens)
Trichophaga tapetzella (Linnaeus)
Tinea pellionella Linnaeus
  pallescentella Stainton
Lindera tessellatella Blanchard
Oinophila v-flava (Haworth)
Plutella maculipennis (Curtis)

Species Described as New

Juania magnifica 67924
paraloxia 67923
loxia 67922
glareola 67921
imitator 67920
imperfecta 67919
chiloma 67918
byssifera 67917
parva 67916
derelicta 67915
minima 67914
abbreviata 67913
nitidissima 67912
grisea 67911
pepita 67910
xerophylla 67909
Fernandocrambus kuscheli 67908
truncus 67907
fundus 67906
corvus 67905
arcus 67904
oxyechus 67903
Crambus divus 67902
Loxostege oxalis 67931
Pyrausta louvinia 67930
Mnesictena tetragramma 67929
Giorgia crena 67928
Scoparia pyraustoides 67927
dela 67926
matuta 67925
Nesochoris holographa 67932
brachystigma 67933
Gnorimoschema hemilitha 67934
melanolepis 67935
Echinoglossa trinota 67936
Pseudarla miranda 67937
Anchimompha melaleuca 67938
Nanodacna indiscriminata 67940
Leuroperna leioptera 67943
Eudolichura exuta 67942
Melitonympha telluris 67941

These species are assigned to 35 genera of which the following are described as new: *Giorgia, Nesochoris, Parasuleima, Pseudarla, Echinoglossa, Anchimompha, Eudolichura,* and *Leuroperna.* In addition, the genera *Platyptilia, Stenoptilia, Elasmopalpus, Oeobia, Nomophila, Pyrausta, Loxostege, Mnesictena, Gnorimoschema, Bedellia, Oinophila, Monopis, Lindera, Trichophaga, Tinea, Plutella, Melitonympha, Martyrhilda,* and *Brenthia* are recorded for the first time from these islands.

In the Juan Fernandez Islands there are two categories of Microlepidoptera: (1) those which have found their way there through the agency of man; (2) those which have arrived through the ages by natural means, or those that have evolved from them.

In the first group are the refuse feeders and household pests and the species attached to various plants grown for food. These are: *Lindera tessellatella* Blanchard, *Monopis crocicapitella* (Clemens), *Tinea pallescentella* Stainton, *Tinea pellionella* Linnaeus, and *Trichophaga tapetzella* (Linneaus), all of which attack woolens and other stored animal products. *Oinophila v-flava* (Haworth), a European species, is reported as feeding on refuse, or fungi on cellar walls. *Endrosis sarcitrella* (Linnaeus), the widely distributed "white-shouldered house moth," attacks everything from wool to stored cereals and dried meat and may be encountered anywhere near human habitation.

It is indeed strange that such cosmopolitan household or stored food-products pests as *Plodia interpunctella* (Hübner), *Ephestia cautella*

(Walker), and *Tineola bisselliella* (Hummel) have not been recovered from these islands. These species are so generally distributed that it seems unlikely the islands have escaped their ravages.

The plant-feeding insect pests are the notorious "potato tuberworm," *Gnorimoschema operculella* (Zeller); *G. absoluta* (Meyrick), also a pest of potato as well as a pest of tomato; the "diamondback moth," *Plutella maculipennis* (Curtis), which is widely distributed throughout most of the world and feeds on both cultivated and native cruciferous plants; and *Bedellia somnulentella* (Zeller), a pest of sweet potato and allied plants.

Six of these cosmopolitan species are found on more than one of the islands. They are *sarcitrella, maculipennis, somnulentella, tessellatella, pellionella,* and *pallescentella.*

The remaining species, or the antecedents from which they have evolved, probably reached the islands by natural means (convection currents, drift, etc.). They are distributed in the following families:

Crambidae	28	Gelechiidae	5
Phycitidae	1	Momphidae	1
Pyraustidae	9	Blastodacnidae	2
Pterophoridae	2	Hyponomeutidae	3
Olethreutidae	1	Glyphipterygidae	1
Tortricidae	4	Psychidae	1
Oecophoridae	1		

Of all the species, including those introduced by commerce, only eight occur on more than one island, and only one occurs on all three. The eight species occurring on two islands are *Giorgia crena,* new species, *Nomophila noctuella* (Denis & Schiffermüller), *Endrosis sarcitrella* (Linnaeus), *Plutella maculipennis* (Curtis), *Bedellia somnulentella* (Zeller), *Lindera tessellatella* Blanchard, *Tinea pallescentella* (Stainton), and *Tinea pellionella* Linnaeus. The one occurring on all three islands is *Oeobia ragonotii* (Butler).

The present record of species of Microlepidoptera indicates 75 percent endemicity, perhaps higher than one should expect from islands so close to a continental mass. The mainland fauna is very poorly known, and undoubtedly there are many more species to be discovered in the islands. When extensive collections are made, we may find a considerably larger number of species common to both areas.

The following table gives a complete roster of species and their distribution, when applicable, outside of the islands. A plus sign or notation denotes presence, and a minus denotes absence.

Distribution of Juan Fernandez Microlepidoptera

	Masa-tierra	Santa Clara	Masa-fuera	Elsewhere
Elasmopalpus angustellus	−	−	+	Chile mainland
Pionea fumipennis	+	−	−	
Loxostege oxalis	+	−	−	
Pyrausta louvinia	+	−	−	
Mnesictena tetragramma	+	−	−	
Giorgia crena	+	−	+	
Nomophila noctuella	+	−	+	Continental Americas, Europe
Oeobia ragonotii	+	+	+	Chile mainland
Scoparia dela	−	−	+	
matuta	−	−	+	
pyraustoides	+	−	−	
Crambus fernandesellus	+	−	−	
divus	+	−	−	
Fernandocrambus fuscus	+	−	−	
oxyechus	+	−	−	
arcus	+	−	−	
truncus	+	−	−	
bäckströmi	+	−	−	
corvus	+	−	−	
fundus	+	−	−	
brunneus	+	−	−	
kuscheli	−	−	+	
Juania annulata	+	−	−	
magnifica	+	−	−	
xerophylla	−	−	+	
pepita	+	−	−	
loxia	+	−	−	
paraloxia	+	−	−	
abbreviata	−	−	+	
grisea	−	−	+	
imitator	−	−	+	
chiloma	+	−	−	
parva	+	−	−	
glareola	+	−	−	
byssifera	+	−	−	
nitidissima	+	−	−	
derelicta	+	−	−	
imperfecta	+	−	−	
minima	+	−	−	
Platyptilia epidelta	+	−	−	Argentina
Stenoptilia partiseca	−	−	+	Argentina
Parasuleima insulana	+	−	−	
Proeulia robinsoni	+	−	−	
griseiceps	+	−	−	
Nesochoris holographa	+	−	−	
brachystigma	+	−	−	
Martyrhilda relegata	+	−	−	

	Masatierra	Santa Clara	Masafuera	Elsewhere
Endrosis sarcitrella	+	–	+	Cosmopolitan
Apothetoeca synaphrista	+	–	–	
Gnorimoschema operculella	+	–	–	Cosmopolitan
absoluta	+	–	–	South America
hemilitha	+	–	–	
melanolepis	–	–	+	
Echinoglossa trinota	+	–	–	
Pseudarla miranda	+	–	–	
Anchimompha melaleuca	–	–	+	
Nanodacna ancora	–	–	+	
indiscriminata	+	–	–	
Plutella maculipennis	–	+	+	Cosmopolitan
Melitonympha telluris	+	–	–	
Eudolichura exuta	–	–	+	
Leuroperna leioptera	–	–	+	
Glyphipterygidae	+	–	–	
Psychidae	+	–	–	
Lindera tessellatella	+	+	–	Australia, New Zealand, Mexico, Fiji Ids., Europe, U.S., Chile mainland.
Monopis crocicapitella	+	–	–	Japan, Micronesia, Americas, Europe
Trichophaga tapetzella	–	–	+	Cosmopolitan
Tinea pallescentella	+	+	–	England, Argentina
pellionella	+	–	+	Cosmopolitan
Bedellia somnulentella	+	–	+	Japan, Guam, Americas?
Oinophila v-flava	+	–	–	Europe, California

The origin of the species, except the ten introduced by man, is obscured in antiquity but certainly the points of origin are several. The majority of the species appear to have their affinities with continental American elements but, because of the rather meager knowledge of the mainland forms, it is impossible to estimate the extent to which this occurs. The enormous development of the Crambidae in the islands has no comparable evolution on the mainland. Apparently the antecedent or antecedents of the Crambidae arrived at an early geologic time and found an unusually favorable environment permitting extensive radiation. Without doubt, further exploration will reveal even a greater number of species in this family.

The Crambidae are contained in three genera, *Crambus*, *Fernandocrambus* and *Juania*. Although the three genera are easily separated on superficial characters, the various genitalic types are found in each

genus. If we were to establish the genera on the basis of genitalia, we should have a quite different arrangement of species. It is, therefore, doubtful that the three so-called genera can be maintained but for convenience in this paper I am retaining them.

Five species are found on the South American mainland as well as in the islands. These are: *Elasmopalpus angustellus*, *Nomophila noctuella*, *Oeobia ragonotii*, *Platyptilia epidelta*, and *Stenoptilia partiseca*. It is not likely that any of these were transported by man.

The genus *Scoparia*, with three species, is well represented in the American continental areas although the genus enjoys its greatest development in New Zealand. We can attribute the origin of the Juan Fernandez species to that area. Although I expressed some misgiving in placing the new species *tetragramma* in the New Zealand genus *Mnesictena* (Meyrick), there appears to be little doubt that it belongs there or very close to it. It is also apparent that *Giorgia*, new genus, is derived from a Western ancestral type, and I have indicated that *Giorgia* appears to be related to *Sufetula* Walker, from the Indian Region. Two species of American moths have already been placed in *Sufetula* (*diminutalis* Walker from the West Indies and *philogeolos* Dyar from North America) so the relationship between this genus and *Giorgia* may not be too remote.

The remaining pyraloid genera, *Pionea* Guenée, *Pyrausta* Shrank, *Loxostege* Hübner, and *Nomophila* Hübner undoubtedly owe their presence in the islands to the American mainland.

The Hyponomeutidae, though represented at present by only four species, have an equal number of genera, one more than in the large family Crambidae. This generic differentiation is comparable to that found on the adjacent mainland, where Meyrick recorded nine genera and emphasized the great development of this family in southern South America.

The four species of Tortricidae and the one species of Olethreutidae are endemic, as are the genera to which they belong.* As previously pointed out, the South American fauna is too imperfectly known to permit establishing a definite relationship between the island and continental forms, but it appears that the tortricid species, at least, have been derived from the mainland elements. The single olethreutid, *Parasuleima insulana* (Aurivillius), is American in origin.

The Oecophoridae and Gelechiidae are American in character (except the introduced *E. sarcitrella* (Linnaeus)) and no real problem of origins arises here. The genus *Martyrhilda* Clarke was described

* Since this was written, Obraztsov (1964, Proc. U. S. Nat. Mus., vol. 116, no. 3501, pp. 183–195, pls. 1–9) has recorded nine species from Central Chile belonging to the tortricid genus *Proeulia* Clarke.

from North America, but also occurs in Europe, and probably will be found in Asia as well. The fact that the island species *M. relegata* (Meyrick) is the only one recorded from the South American fauna is a matter of collecting, or lack of it, and undoubtedly other species will be found.* The gelechiid genera *Apothetoeca* Meyrick and *Pseudarla*, new genus, are New World types while the genus *Gnorimoschema* Busck is widely distributed throughout most of the world.

Key to Genera

1. Forewing divided 2
   Forewing not divided 3
2. Forewing with veins 3, 4, and 5 separate . . . . **Platyptilia**
   Forewing with veins 3, 4, and 5 stalked . . . . **Stenoptilia**
3. Hindwing with veins 7 and 8 stalked or united 4
   Hindwing with veins 7 and 8 separate 15
4. Hindwing with veins 7 and 8 united . . . . **Giorgia**
   Hindwing otherwise 5
5. Forewing with vein 7 absent . . . . **Elasmopalpus**
   Forewing with vein 7 present 6
6. Forewing with vein 7 out of the stalk of 8 and 9 7
   Forewing with vein 7 free 9
7. Forewing with veins 3 and 4 coincident . . . . **Juania**
   Forewing with veins 3 and 4 separate 8
8. Forewing with veins 4 and 5 short stalked; labial palpus at least three times as long as head . . . . **Crambus**
   Forewing with veins 4 and 5 connate or closely approximate; labial palpus not three times as long as head . . . . **Fernandocrambus**
9. Hindwing with veins 4 and 5 stalked 10
   Hindwing with veins 4 and 5 otherwise 11
10. Harpe with spinous process from ventral edge: signum absent . . **Scoparia**
    Harpe without such spinous process; signum present . . . . **Oeobia**
11. Hindwing with veins 4 and 5 closely approximate for about one-third their lengths from base 12
    Hindwing with veins 4 and 5 divergent from base 13
12. Forewing with veins 3, 4, and 5 about equidistant at base . . . **Nomophila**
    Forewing with vein 3 much farther from 4 than 4 is from 5 . . . **Pyrausta**
13. Frons produced . . . . **Loxostege**
    Frons smooth, rounded 14
14. Hindwing with veins 4 and 5 connate; labial palpus more than twice as long as head . . . . **Mnesictena**
    Hindwing with veins 4 and 5 closely approximate at base; labial palpus not more than twice as long as head . . . . **Pionea**

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* In my volume IV on the Meyrick types of Microlepidoptera, I have transferred to this genus five South American species, recorded from Argentina, Colombia, Ecuador, and Peru.

15. Forewing with vein 1c preserved, at least at margin 21
Forewing with vein 1c absent 16
16. Hindwing with cell open 17
Hindwing with cell closed 18
17. Forewing with vein 11 from middle of cell; apex pointed but not appreciably produced . . . . **Bedellia**
Forewing with vein 11 from outer fourth of cell; apex produced . . **Oinophila**
18. Hindwing with veins 6 and 7 stalked 19
Hindwing with veins 6 and 7 parallel or nearly so 20
19. Hindwing with veins 3 and 4 connate . . . . **Apothetoeca**
Hindwing with veins 3 and 4 separate . . . . **Pseudarla**
20. Forewing with vein 6 separate and 7 and 8 stalked . . . . **Gnorimoschema**
Forewing with veins 7 and 8 stalked, out of vein 6 . . . . . **Echinoglossa**
21. Forewing with accessory cell 22
Forewing without accessory cell 28
22. Second segment of labial palpus with bristles 23
Second segment of labial palpus without bristles 26
23. Forewing with aereole . . . . **Monopis**
Forewing without aereole 24
24. Hindwing with veins 5 and 6 short stalked . . . . **Lindera**
Hindwing otherwise 25
25. Hindwing with veins 5, 6, and 7 equidistant . . . . **Trichophaga**
Hindwing with veins 5 and 6 approximate at base . . . . **Tinea**
26. Forewing with all veins separate 27
Forewing with veins 7 and 8 stalked . . . . **Melitonympha**
27. Hindwing with veins 5 and 6 stalked . . . . **Eudolichura**
Hindwing with veins 5 and 6 separate . . . . **Leuroperna**
28. Hindwing with veins 6 and 7 parallel or nearly so 29
Hindwing otherwise 34
29. Hindwing with veins 5 and 6 stalked 30
Hindwing otherwise 31
30. Forewing with veins 7 and 8 separate . . . . **Plutella**
Forewing with veins 7 and 8 stalked . . . . **Nanodacna**
31. Basal segment of antenna with pecten 32
Basal segment of antenna without pecten 33
32. Forewing with veins 2 and 3 separate . . . . **Endrosis**
Forewing with veins 2 and 3 stalked . . . . **Martyrhilda**
33. Labial palpus short, hardly recurved . . . . **Brenthia**
Labial palpus long, recurved . . . . **Anchimompha**
34. Hindwing with cubital pecten . . . . **Parasuleima**
Hindwing without cubital pecten 35
35. Forewing with vein 2 arising from outer two-thirds of cell; 6, 7, and 8 about equidistant at bases . . . . **Nesochoris**
Forewing with vein 2 arising from three-fifths of cell; vein 6 twice as far from 7 as 7 is from 8 . . . . **Proeulia**

Family Crambidae

Genus *Crambus* Fabricius

The species of *Crambus* are separated by the following key:

Dark dividing line of forewing short and sharply defined.
fernandesellus Hampson
Dark dividing line of forewing long and diffused . . . . . . **divus,** new species

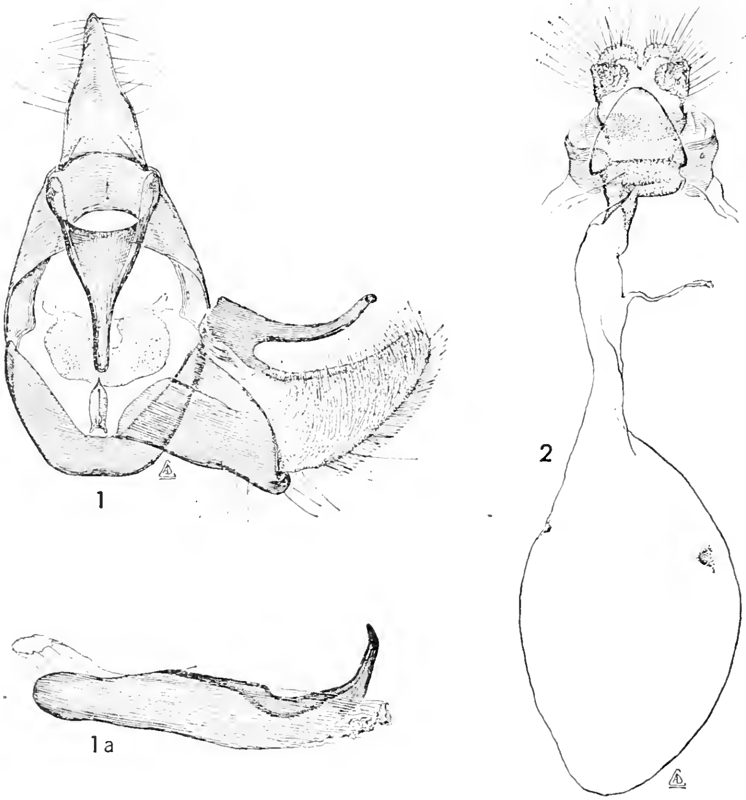
Crambus fernandesellus Hampson

FIGURES 1–2

Crambus fernandesellus Hampson, 1896, Proc. Zool. Soc. London, 1895, p. 931.—Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 263, pl. 2, fig. 9.

Type: British Museum (Natural History).

Type locality: "Juan Fernandez."



FIGURES 1–2.—*Crambus fernandesellus* Hampson: 1, ventral view of male genitalia with left harpe and aedeagus removed; 1a, lateral aspect of aedeagus; 2, ventral view of female genitalia.

Distribution: Masatierra: Plazoleta del Yunque, ♂ (Feb. 20, 1951); Picacho Central, 600 m., ♀ (Feb. 4, 1952).

Both specimens from this collection are larger (30–38 mm.) than the size indicated by Hampson and probably the largest one represents about the maximum that will be found. The hindwings of the female are much lighter than those of the male.

Mr. John D. Bradley has confirmed my identification of the species.

***Crambus divus*, new species**

FIGURE 3

Alar expanse 34 mm.

Labial palpus ocherous white with light brownish suffusion on outer side. Antenna ocherous white with narrow, pale brown, longitudinal line ventrally. Head ocherous white with pale brownish suffusion.

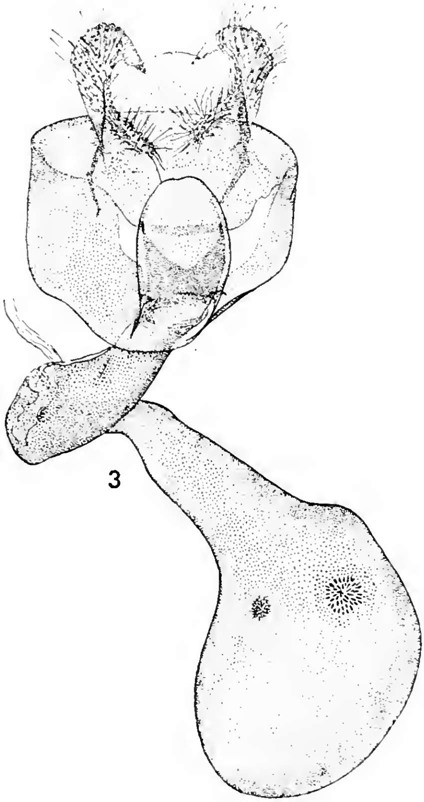


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FIGURE 3.—*Crambus divus*, new species: ventral view of female genitalia.

Thorax light brown. Ground color of forewing ocherous white; extreme edge of costa narrowly brown. Ground color of forewing ocherous white; extreme edge of costa narrowly brown; wing divided

longitudinally by a dark-brown line which fades gradually toward dorsum; in costal half a few yellowish streaks; at outer end of cell, at each angle, a small brown spot; a similar spot on vein 8, about midway between end of cell and apex, and another on tornus; four ill-defined brownish spots on termen; cilia ocherous white with slight brownish suffusion. Hindwing white with slight yellowish tint; cilia white. Legs ocherous white suffused with brown. Abdomen ocherous white with slight infuscation beneath.

Female genitalia (slide 10669): Ventral lip of ostium twice as long as broad, stout. Posterior half of ductus bursae stout, sclerotized; anterior half membranous; inception of ductus seminalis at junction of the two parts of ductus bursae. Signa the usual two, but one greatly reduced in size.

Type: Masatierra: Alto Pangal, 600 m. (Em., Mar. 24, 1955).

Food plant: *Juania australis* (Mart.) Drude ex. Hook. f. (Palmae).

Described from the unique female type. Both *divus* and *fernandesellus* are similar, and might be mistaken for each other, but the dark dividing line of the forewing is short and sharply defined in *fernandesellus* and long and diffused in *divus*. Although the extreme edge of costa, basally, is dark in *divus*, there is a sharply defined, short black line inside costa on *fernandesellus*. The female genitalia are widely different as will be seen by a comparison of the figures. The ventral lip of the ostium of *fernandesellus* is essentially broadly triangular while that of *divus* is oblong; the ductus bursae of *divus* is sclerotized for half its length while that of *fernandesellus* is wholly membranous.

Of all the species of microlepidoptera collected in the islands, this is the only one that was reared. A note by Dr. Kuschel, accompanying the specimen, states "Larva: Alto Pangal, 600 m., Mar. 5, 1955, en hojas nuevas y cerradas de *Juania australis* (Palmae). Ninfa: Mar. 9, 1955. Imago: Mar. 24, 1955." A second note reads, "La larva hace mucho daño en las hojas nuevas de la 'chonta' (*Juania australis*)."

Genus *Fernandocrambus* Aurivillius

Fernandocrambus Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 263.

Type-species: *Fernandocrambus brunneus* Aurivillius, op. cit., p. 264, pl. 11, fig. 12 [hereby designated].

Key to the Species of *Fernandocrambus*

1. Labial palpus buff shaded with drab or fuscous. 2
   Labial palpus otherwise 5

2. Forewing ground color fuscous or brown. 3
Forewing ground color grayish buff; without longitudinal streak; alar expanse 26 mm. . . . . **corvus**, new species
3. Forewing with median longitudinal buff streak; alar expanse 15–17 mm. **fundus**, new species
Forewing without median longitudinal streak 4
4. Forewing with well-defined transverse, pale subterminal line. **brunneus** Aurivillius
Forewing without well-defined transverse subterminal line **fuscus** Aurivillius
5. Forewing with pale longitudinal streak 6
Forewing without longitudinal streak 8
6. Male genitalia with costal process of harpe present; ventral lip of ostium reduced 7
Male genitalia without costal process from harpe; ventral lip of ostium large, expanded posteriorly . . . . **truncus**, new species
7. Armature of aedeagus a strong curved hook; process of sacculus stout, pointed; lip of ostium subrectangular in outline . **bäckströmi** Aurivillius
Armature of aedeagus a barb; process of sacculus not pointed; lip of ostium triangular in outline . . . . **kuschcli**, new species
8. Hindwing grayish fuscous; alar expanse 14–18 mm . **oxyechus**, new species
Hindwing grayish buff; alar expanse 20–27 mm . . . . **arcus**, new species

Fernandocrambus brunneus Aurivillius

Figures 4–6

Fernandocrambus brunneus Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 264, pl. 11, fig. 11.

Alar expanse 18–23 mm.

Male genitalia (slide 10140): Costa of harpe short, strongly sclerotized, with long, slender distal process; cucullus a long, parallel-sided, fleshy lobe. Sacculus broad, strongly sclerotized, terminating in a bluntly pointed, notched process. Uncus straplike, terminating in a blunt point. Gnathos longer than uncus; distal end slightly dilated. Aedeagus stout, straight, armed with a strong, pointed, apical process.

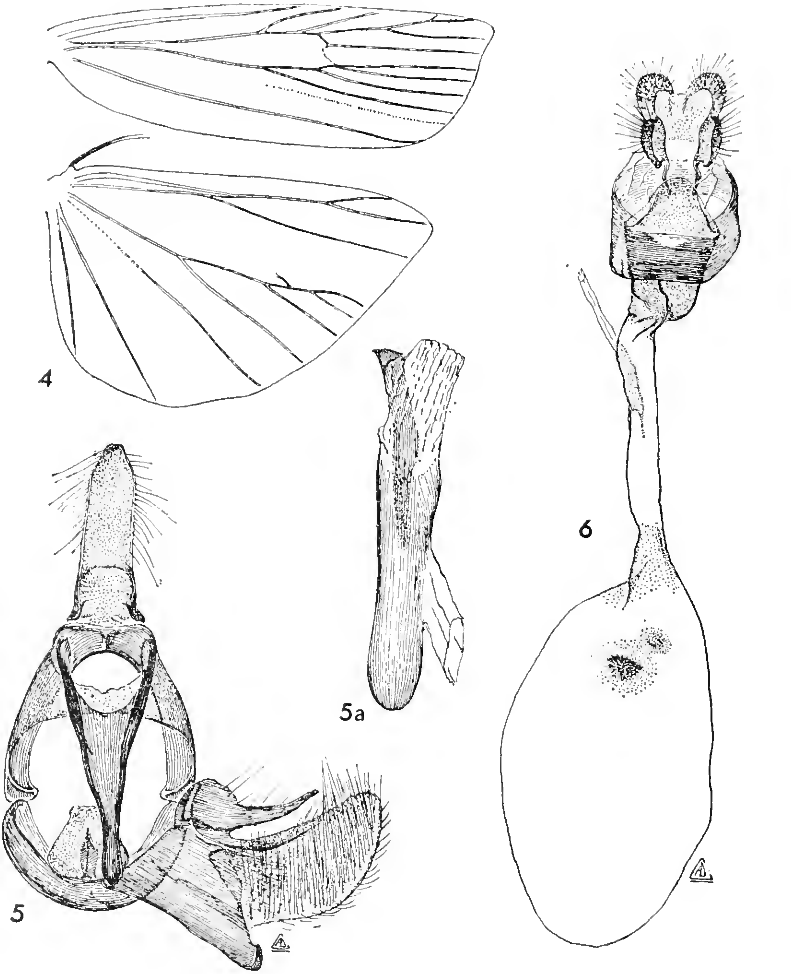
Female genitalia (slide 10141): Ostium wide; ventral lip broadly triangular. Ductus bursae membranous except for a short, widened, sclerotized section before ostium. Ductus seminalis from middle of ductus bursae.

Type: Naturhistoriska Riksmuseum, Stockholm.

Type locality: "Masatierra."

Distribution: Masatierra: Bahía Cumberland, 8 ♂♂, 2 ♀♀ (Mar. 4, 1951), ♀ (Feb. 15, 1951); Villagra, ♂ (Feb. 21, 1951).

In general appearance *brunneus* is similar to *fuscus*. The genitalia of the two, however, differ markedly. The costa of the harpe of *brunneus* is armed with a strongly pronounced process, absent in *fuscus;* the anterior edge of the vinculum of *fuscus* is concave, that of *brunneus* convex. The gnathos of *fuscus* is distorted but that of *brunneus* is nearly straight, tapering.



FIGURES 4–6.—*Fernandocrambus brunneus* Aurivillius: 4, venation of right wings; 5, ventral view of male genitalia with left harpe and aedeagus removed; 5a, lateral aspect of aedeagus; 6, ventral view of female genitalia.

Fernandocrambus fuscus **Aurivillius**

FIGURE 7

Fernandocrambus fuscus Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 264, pl. 11, fig. 13.

Type: Naturhistoriska Riksmuseum, Stockholm.

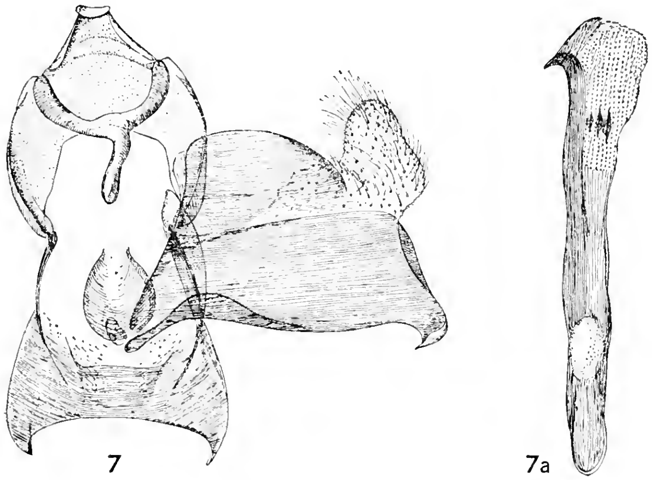
Type locality: "Masatierra."

Alar expanse 19 mm.

Male genitalia (slide 10633): Projection of sacculus a long hook, foreshortened in figure. Costa strongly arched. Aedeagus armed

with a strong distolateral hook. The male genitalia are figured from the type.

Aurivillius described *fuscus* from a unique male; it is the only specimen known.



7 7a

FIGURE 7.—*Fernandocrambus fuscus* Aurivillius: 7, ventral view of male genitalia with left harpe and aedeagus removed; 7a, aedeagus.

***Fernandocrambus oxyechus*, new species**

FIGURES 8–9

Alar expanse 14–18 mm.

Labial palpus grayish fuscous outwardly, grayish buff inwardly. Antenna grayish fuscous with brassy hue basally. Head fuscous, paler posteriorly. Thorax and ground color of forewing fuscous, the latter with a brassy hue; extreme edge of costa, from basal fourth to near apex, pale buff; this color expanded in some specimens to form an ill-defined spot at apical fifth; in some strongly marked specimens a faint, dark line extends outwardly from apical fifth of costa to about vein 6, then inwardly straight to tornus; at end of cell a dark spot, absent or nearly so in some examples; cilia grayish fuscous. Hindwing grayish fuscous; cilia concolorous. Legs buff strongly overlaid with fuscous. Abdomen fuscous above, beneath grayish buff; posterior tip buff.

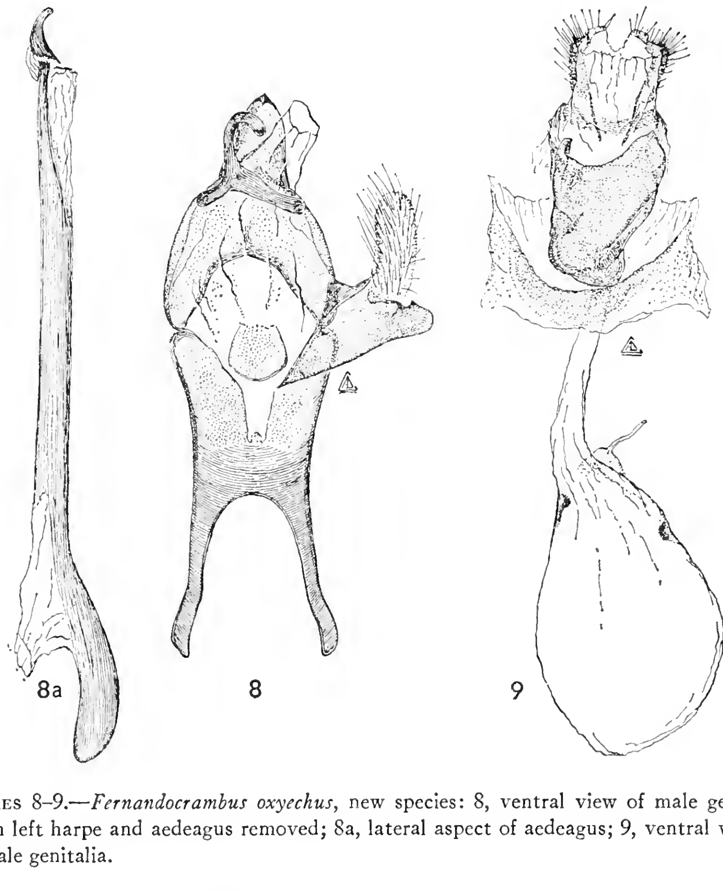
Male genitalia (slide 10365): Vinculum longer than tegumen and uncus combined. Gnathos sharply curved. Costa of harpe short, without marginal projection; cucullus narrow and abruptly turned caudad.

Female genitalia (slide 10255): Ventral lip of ostium greatly dilated, shovel shaped. Signa two sclerotized, scobinate plates.

Type: Masatierra: Bahía Cumberland (Feb. 15, 1951).

Described from the type male and 21 male and female paratypes as follows: Masatierra: Bahía Cumberland, 12♂♂, 9 ♀♀ (February and March dates, 1951).

The male genitalia place this species nearest to *arcus* from which it is distinguished by the very long vinculum. The female, however, suggests a closer relationship with *truncus*.



FIGURES 8–9.—*Fernandocrambus oxyechus*, new species: 8, ventral view of male genitalia with left harpe and aedeagus removed; 8a, lateral aspect of aedeagus; 9, ventral view of female genitalia.

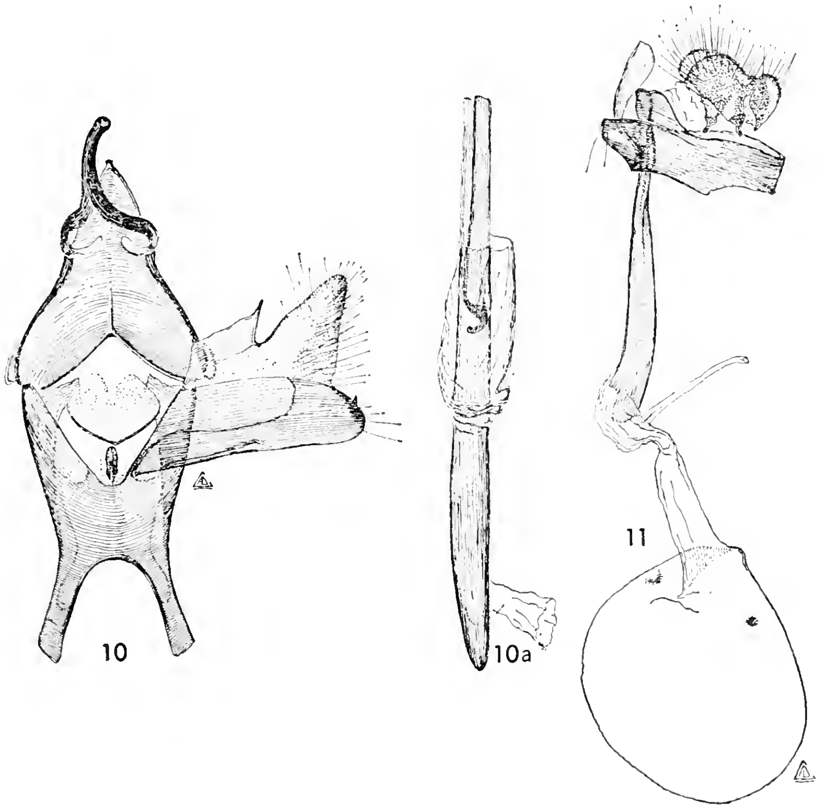
Fernandocrambus arcus, new species

FIGURES 10–11

Alar expanse 20–27 mm.

Labial palpus dark gray, the scales cinereous tipped. Antenna gray except base which is fuscous; scape tipped with cinereous above. Head and thorax dark gray with the scales cinereous tipped; face fuscous; tegula tipped with cinereous. Forewing ground color gray-

ish; base of costa broadly fuscous shading to lighter at middle; on middle of costa an ill-defined fuscous spot followed at three-fourths by a similar one; from the latter a curved, transverse line of fuscous spots terminates in a moderately large fuscous spot before tornus; near middle of tornus a fuscous spot; at end of cell an oval patch of cinereous scales narrowly edged with fuscous; along termen a series of seven fuscous spots; surface of wing overlaid with cinereous scales,



FIGURES 10–11.—*Fernandocrambus arcus*, new species: 10, ventral view of male genitalia with left harpe and aedeagus removed; 10a, aedeagus; 11, lateral aspect of female genitalia.

particularly along dorsum and the outer part of fold; cilia gray with a narrow, median, buff line. Hindwing grayish buff narrowly edged with fuscous; from base of wing a narrow, triangular patch of grayish fuscous expanding toward outer edge; cilia grayish buff with a subbasal grayish band. Legs grayish buff strongly overlaid with fuscous. Abdomen grayish buff with scattered fuscous scales beneath.

Male genitalia (slide 10144): Sacculus greatly enlarged and with a stout thorn at the distal end; costa short with acute point before

cucullus; aedeagus long, slender; vesica armed with a single hooklike cornutus.

Female genitalia (slide 10145): Ductus bursae sclerotized in posterior three-fifths. Ventral lip of ostium long, slender, spoon shaped. Ductus seminalis as indicated in figure.

Type: Masatierra: Bahía Cumberland (Jan. 3, 1952).

Described from the type male and 37 male and female paratypes, all from the same locality. December and January to March dates.

Superficially, *arcus* is similar to *fuscus* but it is a much larger insect. The strong, curved process of the sacculus and the stout hook of the aedeagus of *fuscus* immediately separate it from *arcus*.

Fernandocrambus corvus, new species

FIGURE 12

Alar expanse 26 mm.

Labial palpus buff, irrorate with sordid whitish and fuscous. Antenna fuscous with buff annulations. Head buff above, shading to fuscous on frons. Thorax and ground color of forewing grayish buff; thorax and tegula fuscous anteriorly; base of costa and a line along fold to basal third, fuscous; from costa, slightly beyond middle, an indistinct fuscous line curves to about two-thirds distance across wing; from apical fourth of costa a fuscous line extends obliquely and outwardly to vein 6, then angles inwardly straight to tornus; on dorsum, between the two transverse lines, a conspicuous blackish-fuscous dash; along termen, at the ends of the veins, a series of small fuscous spots; entire surface of wing sparsely irrorate with fuscous; cilia grayish buff. Hindwing shining pale ocherous white; from costa to vein 2, an ill-defined, outwardly curved lunate line; cilia ocherous white. Legs buff, somewhat shaded with fuscous; tarsi shaded with blackish fuscous on outer surface. Abdomen pale buff above, suffused with fuscous beneath.

Female genitalia (slide 10648): Ovipositor lobes edged with a row of strong setae. Ventral lip of ostium produced as a long, slender, straplike process. Slightly more than posterior half of ductus bursae sclerotized; inception of ductus seminalis at junction of sclerotized portion of membranous anterior part of ductus bursae.

Type: Masatierra (no definite locality or date).

Described from the unique female type, in slightly damaged condition. The genitalia of *corvus* are very similar to those of *arcus* but exhibit several substantial differences. The setae along the distal edges of the ovipositor lobes are coarse and stout in *corvus*, not so much so in *arcus;* the posterior edge of the genital plate of *corvus* is straight but that of *arcus* is concave; the sclerite anterior to the ostium is nearly twice as large in *corvus* as it is in *arcus*. In general, the

female genitalia of *corvus* are larger and more robust than in *arcus* although the two species are the same size.

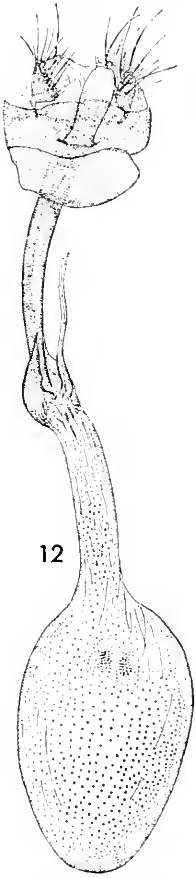


FIGURE 12.—*Fernandocrambus corvus*, new species: ventral view of female genitalia.

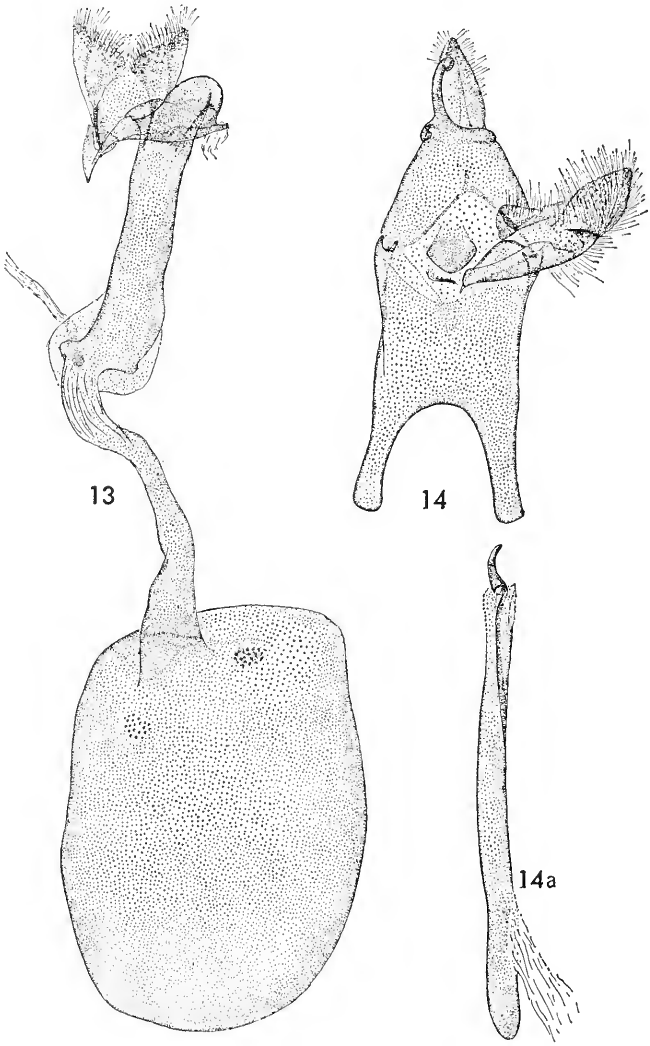
Fernandocrambus fundus, new species

FIGURES 13–14

Alar expanse 15–17 mm.

Labial palpus buff; second segment drab on outer side; third segment almost wholly drab. Antenna drab, except brownish-drab scape. Head brownish drab. Thorax and ground color of forewing fuscous (one specimen with considerable buff on tegula and thorax); from base to end of cell, following fold, a median, longitudinal, buff streak (in one specimen the streak is continued to termen as buff mottling through the ground color); at end of cell, between median streak and costa, a blackish-fuscous shade; along termen an ill-defined series of small blackish-fuscous spots; extreme costa, before apex, suffused

ocherous buff; cilia grayish fuscous. Hindwing grayish fuscous; cilia paler with a dark basal band (in one specimen the cilia are sordid white with the contrasting dark band). Legs buff overlaid with grayish fuscous. Abdomen grayish fuscous, ocherous white beneath, caudally.



FIGURES 13–14.—*Fernandocrambus fundus*, new species: 13, ventral view of female genitalia; 14, ventral view of male genitalia with left harpe and aedeagus removed; 14a, aedeagus.

Male genitalia (slide 10596): Harpe rather narrow; costa very short, straight, sclerotized; cucullus large, at least half the total length of harpe, pointed; sacculus short, broad, terminating in a sharply

pointed triangle. Anellus an oval plate. Gnathos slightly longer than uncus. Uncus moderately broad, pointed. Anterior margin of vinculum with deep, U-shaped excavation. Aedeagus long, slender, armed with a stout, curved spine.

Female genitalia (slide 10258): Ostium broad, ventral lip asymmetrical, short, strongly sclerotized, posterior edge rounded. Posterior half of ductus bursae sclerotized. Inception of ductus seminalis at anterior end of sclerotized part of ductus bursae.

Type: Masatierra: Plazoleta del Yunque, 200 m. (Mar. 3, 1955).

Described from the male type, three male and one female paratypes, all from the type locality, dated (Dec. 28, 1954, Jan. 9, 1952, Mar. 3, 1955).

This is a variable species, no two being exactly alike. The median streak may, or may not, be well defined, in some examples being obscured by the ground color. One specimen exhibits considerable reddish-brown scaling in the dorsal area and all show differences in the intensity of color of the cilia of the hindwings.

The affinities of *fundus* clearly appear to be with *oxyechus* and *arcus*. From *oxyechus* the males of *fundus* can be distinguished by the shallower excavation of the vinculum, the broad, fleshy cucullus, pointed, triangular process of saccculus and the straighter gnathos; from the males of *arcus* by the absence of a costal process of harpe and the absence of a tooth on the terminal process of sacculus. The females of *fundus* can be distinguished from those of both *oxyechus* and *arcus* by the short, asymmetrical ventral lip of ostium.

***Fernandocrambus truncus*, new species**

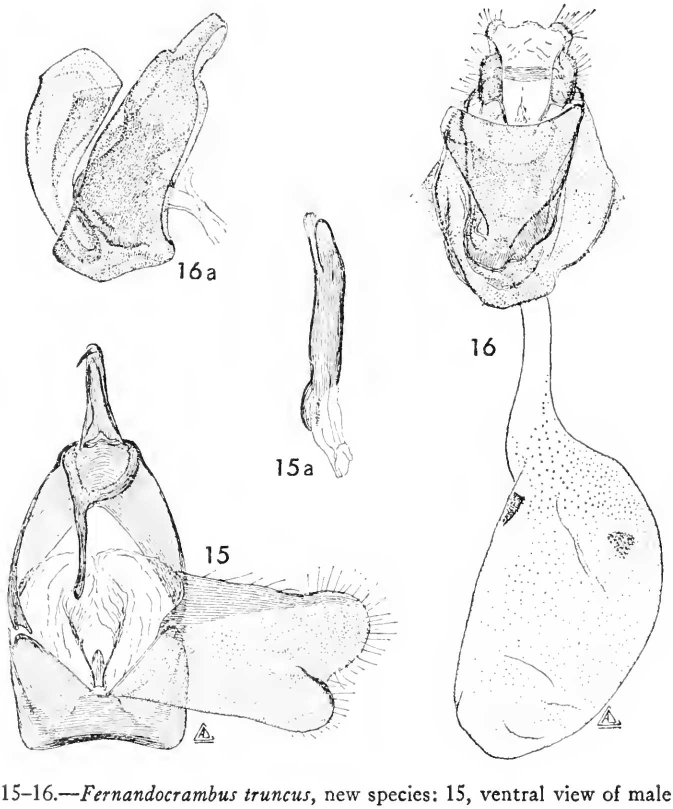
FIGURES 15–16

Alar expanse 14–19 mm.

Labial palpus grayish fuscous outwardly; basal segment and entire innerside ocherous white. Head brownish, face fuscous. Antenna grayish fuscous with ill-defined paler annulations. Thorax and ground color of forewing grayish fuscous; tegula ocherous white; an ocherous-white median streak extends from base of forewing to end of cell, or sometimes nearly to termen, somewhat broader distally than basally and sometimes crossed in outer third by two ill-defined, oblique, grayish-fuscous bars; extreme edge of costa at outer three-fourths ocherous white; cilia slightly paler than ground color. Hindwing gray, deepening to grayish fuscous outwardly; cilia sordid ocherous white with a broad grayish-fuscous basal band. Legs ocherous white suffused and overlaid with grayish fuscous. Abdomen grayish fuscous, somewhat paler beneath and tipped ocherous white. Entire upper surface of insect with shining, brassy hue.

Male genitalia (slide 10174): The parallel-edged harpe, lacking the dorsal and ventral processes, distinguishes this species from other members of the genus. The broad, truncate vinculum is not found elsewhere in the known species of this genus.

Female genitalia (slides 10175, 10176): The extreme development of the sclerotized covering of the ostium, common in crambids, is unusual and easily distinguishes females of *truncus* from other species, except *oxyechus*.



FIGURES 15–16.—*Fernandocrambus truncus*, new species: 15, ventral view of male genitalia with left harpe and aedeagus removed; 15a, aedeagus; 16, ventral view of female genitalia; 16a, lateral view of genital plate and ostium showing posterior part of ductus bursae and inception of ductus seminalis.

Type: Masatierra: Bahía Cumberland (Feb. 15, 1951).

Described from the male type and 8 male and 10 female paratypes as follows: Masatierra: Bahía Cumberland, 8 ♂♂, 9 ♀♀ (January, February, and March dates, 1951–1955); Plazoleta del Yunque, 200 m., ♀ (Dec. 28, 1954).

Similar to *bäckströmi* but averaging a little smaller and with a

much darker ground color and more sharply contrasted pale, longitudinal streak of forewing.

Fernandocrambus bäckströmi Aurivillius

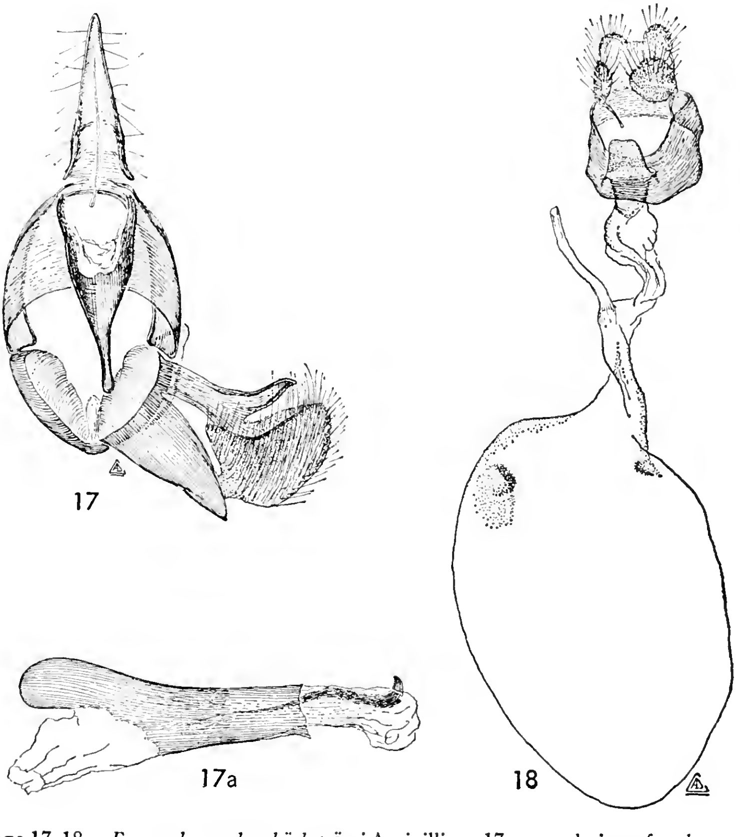
Figures 17–18

Fernandocrambus bäckströmi Aurivillius, 1922 *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 264, pl. 11, fig. 12.

Type: Naturhistoriska Riksmuseum, Stockholm.

Type locality: "Masatierra."

Distribution: Masatierra: Bahía Cumberland 15 ♂♂, 34 ♀♀ (January to March dates); Alto Inglés, 600 m. ♀ (Feb. 6, 1952); Miradero del



Figures 17–18.—*Fernandocrambus bäckströmi* Aurivillius: 17, ventral view of male genitalia with left harpe and aedeagus removed; 17a, aedeagus; 18, ventral view of female genitalia.

Selkirk, 580 m. 2 ♂♂ (Feb. 15, 1951); Plazoleta del Yunque, 200 m., 3 ♂♂ (Feb. 20, 1951); Salsipuedes, 400 m., ♀ (Mar. 5, 1951); Villagra, ♂ (Feb. 22, 1951); 2 ♀♀ (Feb. 21–22, 1951).

In his description of this species Aurivillius included specimens from Masafuera but all the Masafuera specimens belong to the closely similar new species, *kuscheli*, which follows.

I have examined eight slides of the genitalia of this species, including the type, and all agree. The male genitalia are figured from a specimen from Plazoleta del Yunque (slide 10146), and the female from a specimen from Bahía Cumberland (slide 10148).

The series from Bahía Cumberland contains one specimen with an unusual amount of white scaling on forewing, so that the specimen is grayish in aspect, but the genitalia place it here.

In the Naturhistoriska Riksmuseum, Stockholm, there is a female of this species labeled "Masafuera." It appears that the Stockholm specimen was mislabelled because *bäckströmi* is confined to Masatierra.

Fernandocrambus kuscheli, new species

FIGURES 19–20

Alar expanse 14–22 mm.

Labial palpus drab, paler above and inwardly. Antenna drab, somewhat lighter basally and darker apically. Head buff. Thorax and forewing drab; basal fourth of costa darker; from base of wing to end of cell a grayish-buff longitudinal streak broader at end of cell than at base; at the end of cell a few scattered fuscous scales; around termen an ill-defined series of small fuscous spots; cilia light drab with a few darker scales mixed. Hindwing grayish fuscous, cilia grayish buff with a dark subbasal line. Legs grayish buff overlaid with drab. Abdomen grayish fuscous above, grayish buff beneath.

Male genitalia (slide 10598 [type], 10599): Similar to *bäckströmi* but easily distinguished from it by the shape of the armature of the aedeagus. In *bäckströmi* there is a strong, curved apical hook but in *kuscheli* this takes the form of a barb, rather than a hook, with a strong spine directed basad.

Female genitalia (slide 10641): The only significant difference between the female genitalia of *bäckströmi* and *kuscheli* lies in the shape of the ventral lip of the ostium. In *bäckströmi* this is subrectangular in outline but in *kuscheli* it is broad basally and triangular.

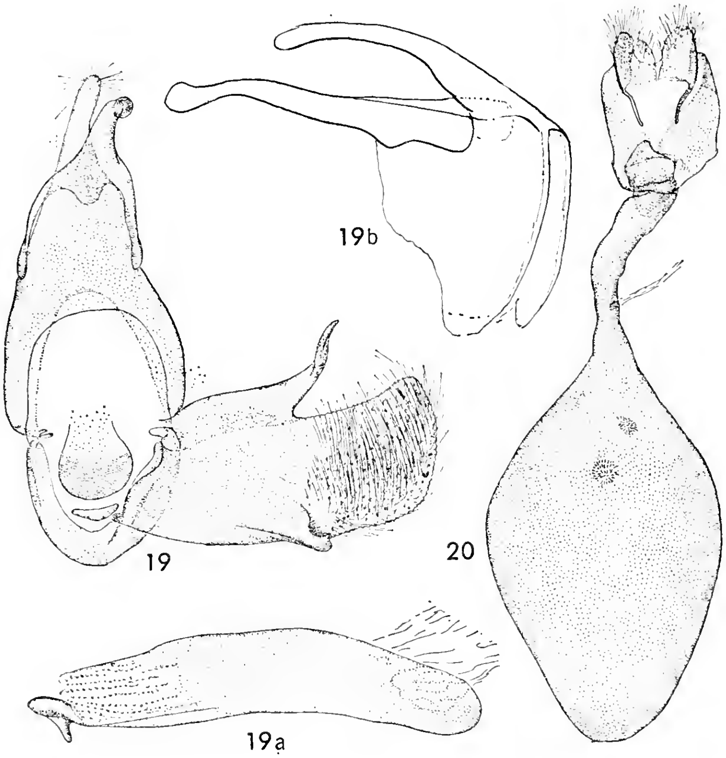
Type: Masafuera: La Correspondencia, 1150 m. (Jan. 28, 1955).

Described from the type male and 61 male and female paratypes as follows: Masafuera: Inocentes Bajos, 1000 m., 7 ♂♂, 2 ♀♀ (Jan. 27, 1952); La Correspondencia, 1150 m. 13 ♂♂, 23 ♀♀ (Jan. 25 to Feb. 21, 1955); Quebrada de la Calavera, ♀ (Jan. 15, 1952); Quebrada de las Casas 7 ♂♂, 5 ♀♀ (Jan. 16–19, 1952, Feb. 21, 1955); Quebrada de las Vacas, ♀ (Jan. 17, 1952).

Superficially *kuscheli* is indistinguishable from *bäckströmi*, particularly when the specimens are worn, but the females of the latter

average larger than those of the former. The genitalia leave no doubt about the identities of the two and each is endemic on its own island.

One male labelled only "Masafuera" is in the collection of the Naturhistoriska Riksmuseum, Stockholm.



FIGURES 19–20.—*Fernandocrambus kuscheli*, new species: 19, ventral view of male genitalia with left harpe and aedeagus removed; 19a, aedeagus; 19b, lateral outline of uncus and gnathos; 20, ventral view of female genitalia.

Genus *Juania* Aurivillius

Juania Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 264.

Type-species: *Juania annulata* Aurivillius, op. cit., p. 265, pl. 11, fig. 15 [by monotypy].

Key to the Species of *Juania*

1.	Alar expanse 17 mm. or more	2
	Alar expanse 16 mm. or less	5
2.	Alar expanse less than 25 mm	3
	Alar expanse more than 25 mm	**magnifica**, new species

3. Forewing with at least two transverse lines but without conspicuous longitudinal streak 4
   Forewing without transverse lines; longitudinal streak well defined. **imperfecta,** new species
4. Labial palpus white marked with dark gray; forewing without trace of yellowish coloring . . . . **xerophyila,** new species
   Labial palpus otherwise; forewing with varying amounts of yellowish coloring . . . . **annulata** Aurivillius
5. Labial palpus ground color white or whitish 10
   Labial palpus otherwise 6
6. Alar expanse 12 mm. or less 7
   Alar expanse 14 mm., a distinct, slender, buff, longitudinal line from base of forewing to termen . . . . **byssifera,** new species
7. Forewing with longitudinal streak 8
   Forewing without longitudinal streak . . . . . . **derelicta,** new species
8. Longitudinal streak of forewing uninterrupted 9
   Longitudinal streak of forewing interrupted twice by bars of ground color. **imitator,** new species
9. Forewing with apical cilia pale and confluent with longitudinal streak; brassy hue of forewing absent . . . . **glareola,** new species
   Forewing with apical cilia pale but not confluent with longitudinal streak; brassy hue of forewing present . . . . **chiloma,** new species
10. Hindwing sordid white . . . . **abbreviata,** new species
    Hindwing otherwise 11
11. Alar expanse 12 mm. or more 12
    Alar expanse 10 mm. or less . . . . **parva,** new species
12. Forewing with white-centered, black or blackish-fuscous spot at end of cell 13
    Forewing otherwise 14
13. Alar expanse 14–16 mm., forewing with black, transverse line from costal third to middorsum preceded by dense sordid white scaling. **grisea,** new species
    Alar expanse 12 mm., forewing with transverse band indicated by three ill-defined blackish-fuscous spots . . . . **minima,** new species
14. Forewing with whitish patch in basal fifth 15
    Forewing without such patch 16
15. Forewing with large, ovate, light spot in central area . **paraloxia,** new species
    Forewing without such light spot . . . . **loxia,** new species
16. Forewing with brassy hue . . . . **nitidissima,** new species
    Forewing without brassy hue . . . . **pepita,** new species

Juania annulata Aurivillius

Figures 21–22

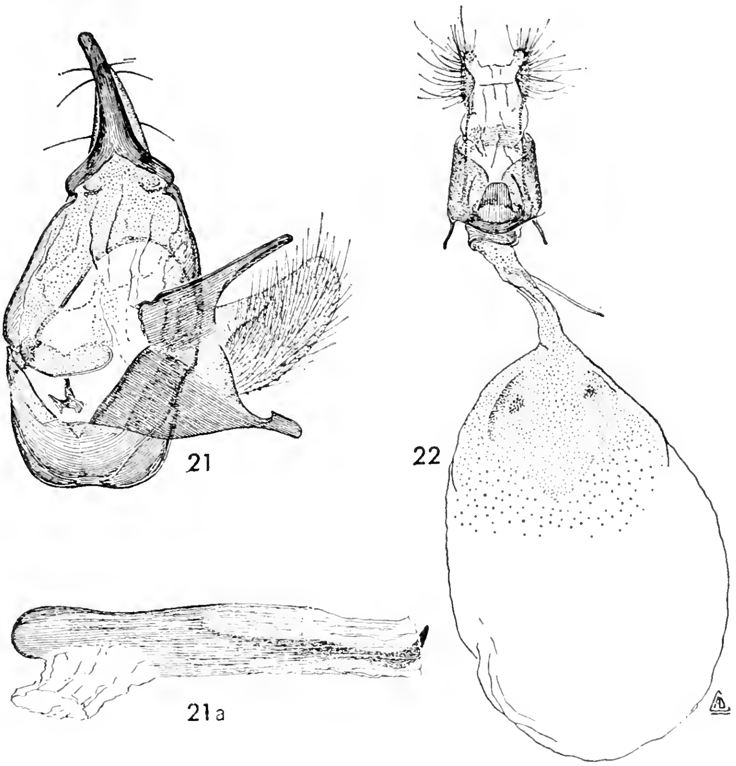
Juania annulata Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 265, pl. 11, fig. 15.

Type locality: "Masatierra."

Lectotype: ♀, Masatierra, "Bäckström, mars" (slide 10634). A small white label bears the inscription "*Juania annulata* Aur." The specimen with the above information is hereby designated lectotype and is deposited in the Naturhistoriska Riksmuseum, Stockholm.

Distribution: Masatierra: Bahía Cumberland, 3 ♂♂, 6 ♀♀ (Feb. 15 to Mar. 3, 1951; Dec. 27, 1954 to Mar. 10, 1955); Plazoleta del Yunque, 200–220 m., 8 ♂♂, ♀ (Jan. 2, 1952, Dec. 28, 1954, Mar. 3, 1955); Villagra, 2 ♂♂ (Feb. 21, 1951).

Aurivillius described this species from two female specimens but he failed to designate a type. When the two were examined recently, one lacked the abdomen; the one with the abdomen was selected as the lectotype.



FIGURES 21–22.—*Juania annulata* Aurivillius: 21, ventral view of male genitalia with left harpe and aedeagus removed; 21a, aedeagus; 22, ventral view of female genitalia.

There is considerable variation in the intensity of the markings of *annulata* and the size varies from 17 to 21 mm. The original figure of the wings is an excellent representation of the average specimen, and the genitalia leave no doubt about the identity of the variable examples. The male genitalia are figured from a specimen from Villagra (slide 10260) and the female genitalia from a specimen from Bahía Cumberland (slide 10259).

***Juania xerophylla*, new species**

FIGURE 23

Alar expanse 17–18 mm.

Labial palpus white; second segment largely overlaid with dark gray on outer surface with a few scattered white scales mixed; third segment almost wholly dark gray. Antenna and head blackish fuscous, the latter with a few white scales posteriorly. Thorax white beneath, blackish fuscous above; posterior edge of collar, tip of tegula and posterior tip of thorax white. Ground color of forewing cinereous, more or less overlaid with fuscous, and dark markings blackish

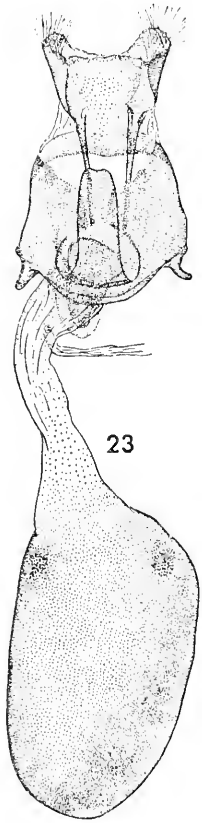


FIGURE 23.—*Juania xerophylla*, new species: ventral view of female genitalia.

fuscous; basal fifth blackish fuscous, the color extended narrowly nearly to middorsum; from basal third of costa, to slightly beyond middle of dorsum, an outwardly oblique, blackish-fuscous transverse line, wider on costa and in cell; from apical fourth of costa an irregular, narrow, blackish-fuscous transverse line extends to tornus; at the end of cell, between the two transverse lines, a white-centered blackish-

fuscous dot; cilia grayish with fuscous and white scales mixed. Hindwing pale grayish basally, shading to fuscous terminally; cilia sordid whitish with a fuscous basal line. Legs fuscous, banded and irrorate with white. Abdomen blackish fuscous.

Female genitalia (slide 10659): Genital plate very strongly sclerotized. Ventral lip of ostium straplike, somewhat narrower distally than proximally. Ductus bursae membranous except posteriorly where it is somewhat sclerotized. Inception of ductus seminalis at about posterior fourth of ductus bursae.

Type: Masafuera: La Correspondencia, 1150 m. (Jan. 25, 1955).

Described from the type female and two female paratypes from the same locality (Jan. 28, 1955; Jan. 3, 1955). One of the paratypes from which the species is figured, is somewhat darker than the type because of the more extensive development of the dark markings.

In pattern this species is similar to *annulata* and, like it, is variable; but *xerophylla* is a smaller moth and exhibits none of the yellowish coloring encountered so often in *annulata.* In genitalia *xerophylla* adheres to the usual type but the area around the ostium is more strongly sclerotized than in most species. The ventral lip of the ostium is much longer in *xerophylla* than in *annulata* as can be seen by a comparison of the figures.

Juania pepita, **new species**

FIGURE 24

Alar expanse 12–14 mm.

Labial palpus white; second segment overlaid with grayish fuscous on outer surface; third segment almost wholly grayish fuscous but with some white remaining on inner surface. Antenna and head grayish fuscous, the latter with a few scattered white scales on frons and posteriorly. Thorax white beneath, grayish fuscous above. Ground color of forewing cinereous but the whole wing almost entirely overlaid with grayish fuscous; markings obscure; base of wing grayish fuscous; from basal third of costa an outwardly oblique, transverse, grayish-fuscous line extends to middorsum, the line broadening out in middle of cell, forming a lobe in dorsal half of wing to apical third; from apical third of costa a slender, outwardly oblique line slants to about vein 5 where the end of the line widens to form a small subquadrate lobe; between the end of this mark and the preceding transverse line is a small grayish-centered grayish-fuscous spot; cilia cinereous with considerable infuscation. Hindwing light grayish fuscous; cilia concolorous with a somewhat darker basal line. Legs cinereous overlaid and banded with grayish fuscous. Abdomen grayish fuscous with some cinereous scaling beneath.

Female genitalia (slides 10366 and 10661): Area surrounding ostium membranous. Ventral lip of ostium spatulate, about half as long as ductus bursae. Ductus bursae sclerotized in posterior half. Inception of ductus seminalis at middle of ductus bursae.

Type: Masatierra: Villagra (Feb. 22, 1951).

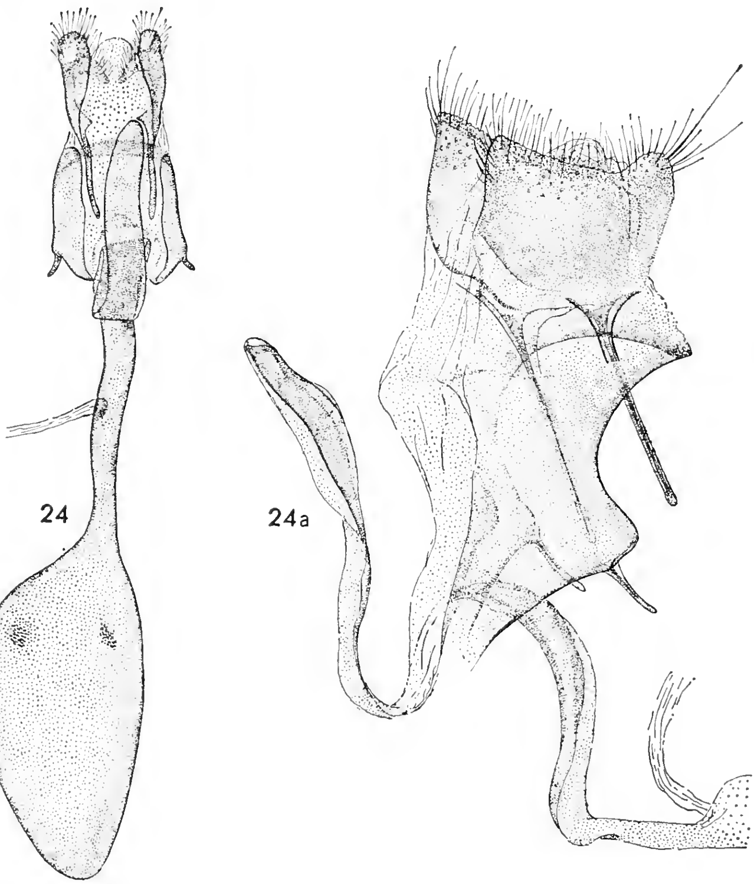


FIGURE 24.—*Juania pepita*, new species: 24, ventral view of female genitalia; 24a, lateral aspect of posterior structures of female genitalia, enlarged.

Described from the type female and four female paratypes, as follows: Masatierra: Villagra, 3 ♀♀ (Feb. 22, 1951); Bahía Cumberland, ♀ (Mar. 10, 1951).

The specimens of this species are not in good condition but, taken together, it is possible to give an accurate description. Because of the considerable infuscation, the pattern is much obscured in some specimens, this type of variability being the rule rather than the exception, in this genus. All of the species of the group to which

pepita belongs are similarly colored, for the most part, but *pepita* is probably nearest to *xerophylla*. The two can be distinguished easily by examination and comparison of the genitalia. The membranous area surrounding the ostium and the usually long lower lip of ostium of *pepita*, contrasted with the strongly sclerotized genital plate and much shorter lower lip of ostium of *xerophylla*, serve to separate the two.

Juania grisea, new species

FIGURES 25–26

Alar expanse 14–16 mm.

Labial palpus sordid white; second segment overlaid with blackish fuscous on outer side and also apically on inner side; third segment almost wholly blackish fuscous. Head blackish fuscous, somewhat iridescent; antenna slightly lighter than head, dull. Thorax blackish fuscous; posterior edge of collar and tip of tegula with a few large, sordid-white scales. Forewing ground color blackish fuscous; basal area black; from costal third a black, irregular, outwardly oblique, transverse line extends to middorsum, is preceded by a rather dense sordid-white scaling and followed by a white-centered black spot at end of cell; at apical fourth a very irregular, black, transverse line extends to tornus and is both preceded and followed by sordid-white scaling, particularly in terminal area; on termen a series of three or four small black dots; cilia fuscous with a few white scales mixed; on underside a sometimes conspicuous black spot, preceded and followed by light scaling from which arises a transverse fuscous band. Hindwing grayish fuscous, paler basally; cilia lighter than terminal area but with a dark basal line; underside marked with an outer fuscous band which is always preceded, and sometimes followed, by light scaling. Legs grayish fuscous irrorate and narrowly banded with sordid white. Abdomen grayish fuscous above, sordid white beneath.

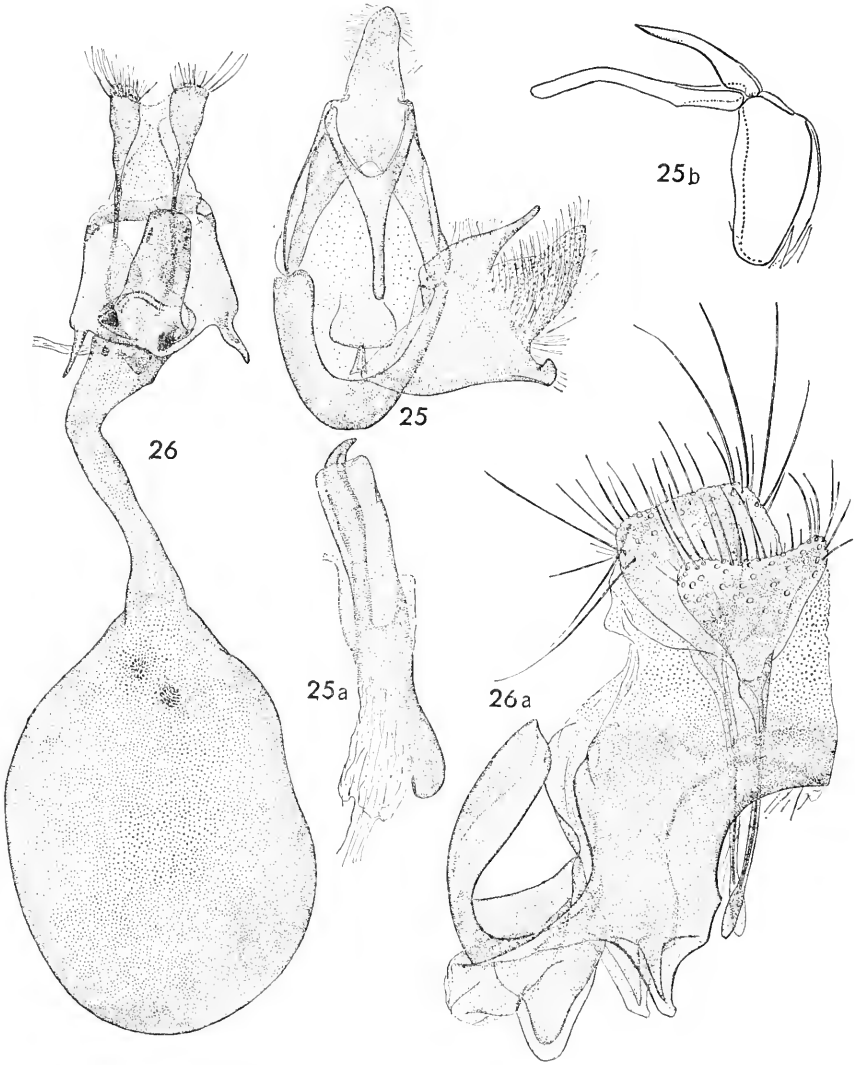
Male genitalia (slides 10707, 10246, 10693): Gnathos less than twice the length of uncus. Costal process of harpe digitate, curved. Cucullus triangular, pointed. Sacculus with ventral edge nearly straight. Aedeagus armed with a long, strong hook.

Female genitalia (slides 10660, 10247, 10248, 10694): Ostium rather large, periphery strongly sclerotized; lip of ostium stout, broad, tapering slightly posteriorly, truncate. Ductus bursae membranous except for short area before ostium and with strongly sclerotized, small, conical evagination dorsally before ostium. Inception of ductus seminalis at about posterior third.

Type: Masafuera: Cordón del Barril, 1200 m. (Feb. 17, 1955).

Described from the female type, 10 female and 5 male paratypes as follows: Masafuera: Cordón del Barril, 1200 m., 3 ♀♀, ♂ (Feb. 17,

1955); Quebrada de las Casas, 7 ♀♀, 3 ♂♂ (Jan. 16–19, 1952; Jan. 22, 1955), Quebrada de las Vacas, ♂ (Jan. 17, 1951).



Figures 25–26.—*Juania grisea*, new species: 25, ventral view of male genitalia with left harpe and aedeagus removed; 25a, aedeagus; 25b, lateral outline of tegumen, uncus and gnathos; 26, ventral view of female genitalia; 26a, lateral aspect of posterior portion of female genitalia.

This is a very variable species and it is difficult to find an "average" specimen to serve as type. In selecting the type I chose a female, found in copula with one of the male paratypes, with markings approximately between the extremes. Two of the female paratypes have

very strongly marked white areas between the dark basal area and first transverse line. Actually, the white scaling is so dense that the light areas appear as oblique white bands. In one specimen, also, the white scales are mixed with ocherous but only one shows this feature. In other paratypes the white scaling is almost nonexistent and even the dark markings are obscured. On the underside several variations of the dark markings, usually preceded and followed by light scaling, are found. These consist of breaks in the transverse bands, complete replacement of the light terminal areas, with fuscous shading into the lines with the consequent reduction of the transverse line of forewing to an obscured costal spot. Despite all these variations, a series of 10 male and female slides leaves only one conclusion to be drawn—that these represent one species only.

In genitalia, *grisea* is nearest *abbreviata* from which it differs as described under the latter species.

Juania nitidissima, new species

FIGURE 27

Alar expanse 13 mm.

Labial palpus creamy white; second segment dark gray on outer side except ventrally; third segment wholly overlaid with dark gray. Antenna grayish fuscous. Head, thorax, and ground color of forewing grayish fuscous with brassy hue; tegula somewhat lighter than center of thorax; in cell and along termen fuscous shading but no distinct, well-defined dark markings; cilia gray with a narrow, dark, basal line. Hindwing grayish fuscous, slightly lighter basally; cilia grayish fuscous with darker basal line. Legs gray, hindtibia and tarsi paler. Abdomen gray, paler beneath.

Female genitalia (slide 10703): Ventral lip of ostium very short, broad, strongly sclerotized. Posterior half of ductus bursae broad, flattened, strongly sclerotized, preceded by a short, lightly ribbed, narrower part which gives rise to the ductus seminalis from about middle.

Type: Masatierra: Cerro Alto, 600 m. (Feb. 1, 1952).

Described from the unique female type. This smooth-winged, virtually unmarked, species might easily be confused with a rubbed or worn specimen of *grisea*, but the genitalia of the two are widely different and enable ready identification. The long, stout, ventral lip of the ostium of *grisea* immediately distinguishes it from *nitidissima*. The dull, brassy luster of *nitidissima* is also a feature that distinguishes it from *grisea*.

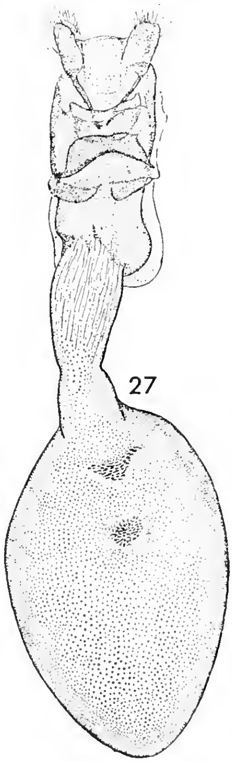


FIGURE 27.—*Juania nitidissima*, new species: ventral view of female genitalia.

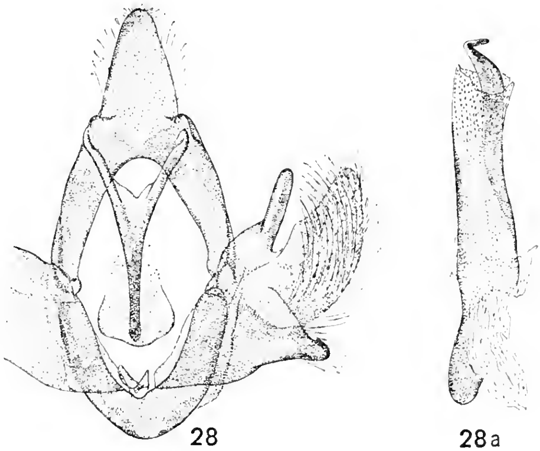
Juania abbreviata, new species

FIGURE 28

Alar expanse 14 mm.

Labial palpus with basal segment white, second and third segments blackish fuscous. Antenna, head, thorax, and ground color of forewing blackish fuscous; antenna with slightly paler annulations; head with slight purplish cast; thorax with white scaling, particularly posteriorly and at tip of tegula; forewing with considerable white scaling; base of forewing black; from basal third of costa to slightly beyond middle of dorsum, an irregular, oblique, transverse black line preceded by white scales; from apical third of costa to tornus an irregular, angulate, transverse black line; cilia grayish fuscous with a few scattered white scales mixed; underside of forewing washed with white and with an outwardly curved, fuscous band slightly beyond apical third. Hindwing sordid white; termen broadly edged with fuscous, interrupted near inner edge by a fine line of ground color; cilia grayish fuscous, white tipped, with a dark subbasal line;

underside with a narrow, fuscous subterminal band. Legs blackish fuscous; tibiae and tarsi white tipped. Abdomen grayish fuscous, with sparse sordid-white scaling beneath; posterior tip ocherous white.



28 28a

FIGURE 28.—*Juania abbreviata*, new species: 28, ventral view of male genitalia with left harpe and aedeagus removed; 28a, aedeagus.

Male genitalia (slide 10689): Typical of the group but with a stout, overall appearance. Gnathos more than twice the length of uncus Costal process of harpe fingerlike, apex rounded. Sacculus strongly sclerotized, broad, ventral edge emarginate. Aedeagus armed with a long, slender hook.

Type: Masafuera: La Correspondencia, 1300 m. (Jan. 20, 1952).

Described from the unique male type. The white hindwings, with the contrasting fuscous terminal band, distinguish *abbreviata* from all the other similar small species of *Juania*. In male genitalia it is nearest *grisea* but can be distinguished from it by the longer, parallel-sided cucullus, broader sacculus, and the more slender hook of the aedeagus.

Juania minima, new species

FIGURE 29

Alar expanse 12 mm.

Labial palpus white; second segment grayish fuscous on outer side except base and ventrally; terminal segment grayish fuscous except basally and ventrally. Antenna grayish fuscous with a small blackish spot above on each segment. Head fuscous, frons pale grayish. Thorax fuscous with faint iridescence; tegula and posterior end of thorax with pale grayish scales mixed. Forewing

ground color grayish fuscous; sparse, scattered, white scales over surface particularly in apical third; basal third of forewing diffused blackish fuscous, followed by an oblique paler band of ground color; beyond this, from basal third of costa to middorsum, an indistinct, outwardly oblique band indicated by three, diffuse, ill-defined blackish-fuscous spots; at the end of cell a blackish-fuscous, white-centered spot connected with a large lobe of blackish fuscous extending toward dorsum; at apical fourth, in costal half of wing, a blackish-fuscous spot; cilia grayish fuscous with a few darker scales mixed. Hindwing grayish fuscous, somewhat darker toward termen; cilia grayish fuscous with a darker basal band. Legs grayish fuscous with scattered white and grayish scales mixed; tibiae and tarsi whitish annulated. Abdomen grayish fuscous, paler beneath.

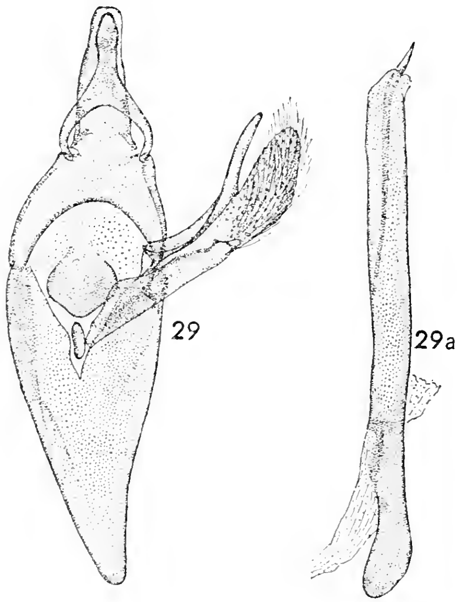


FIGURE 29.—*Juania minima*, new species: 29, ventral view of male genitalia with left harpe and aedeagus removed; 29a, aedeagus.

Male genitalia (slide 10697): Costal process of harpe long, slender, slightly curved, digitate; sacculus produced as a short, strong point. Uncus narrow, truncate. Gnathos slightly longer than uncus, distal end slightly dilated. Vinculum elongate, longer than uncus and tegumen combined. Aedeagus long, slender, armed with a slender, slightly curved process.

Type: Masatierra: Plazoleta del Yunque (Feb. 12, 1951).

Described from the unique male type. This is one of the "gray" species, gray in superficial appearance because of the combination

of the component colors and markings. The genitalia of *minima*, because of the development of the vinculum, easily separate it from the other species. It is probably more closely related to *grisea* than to any of the other species. In addition to the differences in the vincula of the two species, *minima* can be separated from *grisea* by the unusually long aedeagus with its long, slender, pointed process.

Juania derelicta, new species

FIGURE 30

Alar expanse 11 mm.

Labial palpus buff; second and third segments suffused grayish fuscous on outer side. Head, thorax, and ground color of forewing

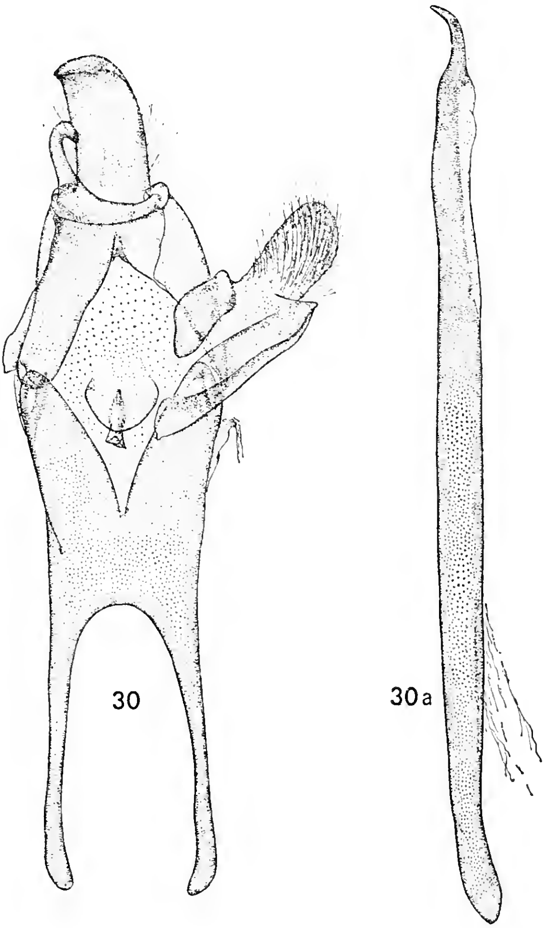


FIGURE 30.—*Juania derelicta*, new species: 30, ventral view of male genitalia with left harpe and aedeagus removed; 30a, aedeagus.

grayish fuscous, the forewing with a slight coppery luster; posterior tip of tegula and posterior end of thorax somewhat lighter than ground color; extreme costal edge of forewing, between middle and apical fourth, buff; a spot of pale color on termen; cilia grayish. Hindwing grayish fuscous; cilia a shade lighter with a dark basal band. Legs grayish with slight luster; distal ends of tibiae with ill-defined, buff annulations. Abdomen grayish fuscous, somewhat lighter beneath; posterior tip pale gray.

Male genitalia (slide 10708): Harpe broad; costa short, strongly sclerotized, distal end abruptly truncated; cucullus a fleshy, parallel-sided lobe; sacculus elongate, strongly sclerotized, terminating in a broadly triangular process. Anellus a broad crescent. Gnathos curved, asymmetrical, about as long as uncus. Uncus long, wide, curved ventrad. Vinculum longer than uncus and tegumen combined; anterior edge cleft for slightly more than half the entire length. Aedeagus long and slender, terminating in a gently curved hook.

Type: Masatierra: El Camote, 600 m. (Dec. 28, 1954).

Described from the unique type male. The type is not in good condition and better material may necessitate altering the description. The genitalia, however, are so striking and distinct that it will not be difficult to determine additional material when it comes to hand. A parallel development of the vinculum is seen in *Fernandocrambus oxyechus* but that of *derelicta* is even more exaggerated.

This species belongs in the *chiloma-glareola* group but the vinculum alone will separate *derelicta* from the other two.

Juania parva, new species

Figure 31

Alar expanse 9 mm.

Labial palpus white; second segment on outer side, and all third segment except extreme tip, dark mouse gray. Antenna, head, thorax, and ground color of forewing blackish fuscous; face sordid white; thorax with considerable sordid-white scaling mixed; basal patch of forewing black, outer edge oblique from costa to dorsum; dorsal half of wing overlaid with sordid white interrupted by irregular, black, transverse lines; in costal half of wing a few scattered sordid-white scales; cilia light grayish fuscous, mixed with white, and with a white spot just below apex and one on midtermen. Hindwing drab, somewhat darker toward outer margin; cilia grayish mixed with whitish apically and banded with grayish fuscous. Abdomen gray, posterior tip ocherous white.

Male genitalia (slide 10706): Ventral edge of sacculus thickened; distal end terminating in a large, strongly sclerotized hook. Costa of harpe short, triangular. Cucullus small, slender, weak. Anellus

a long pear-shaped plate. Vinculum terminating in two widely separated, blunt points. Gnathos asymmetrical, curved. Uncus short, rectangular, posterior edge excavated. Aedeagus robust, armed with a lateroterminal pair of teeth.

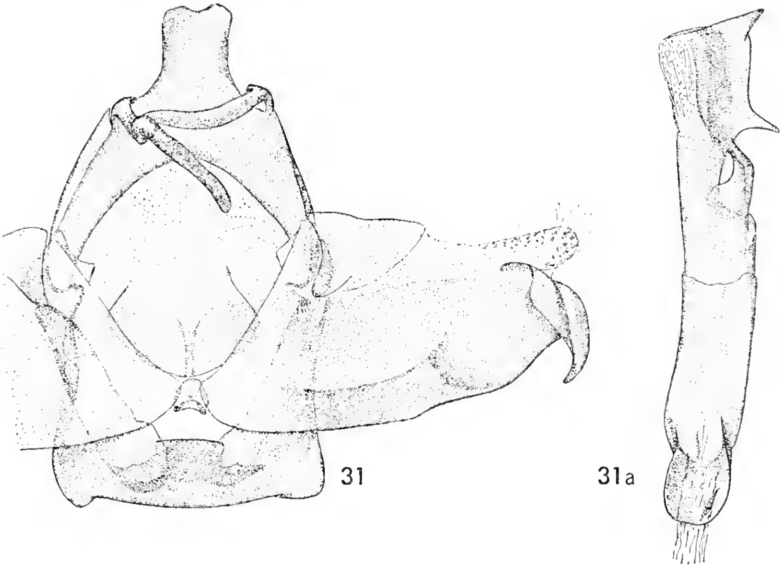


FIGURE 31.—*Juania parva*, new species: 31, ventral view of male genitalia with left harpe and aedeagus removed; 31a, aedeagus.

Type: Masatierra: El Pangal, 350 m. (Feb. 18, 1951).

Described from the unique male type. This is the smallest of the known species of *Juania* and appears to be most nearly related to *chiloma*. It differs from that species by the paired teeth of the aedeagus, the very slender, weak cucullus and the long, strong terminal hook of sacculus; also, *parva* lacks any suggestion of the buff longitudinal area of forewing of *chiloma*.

Juania byssifera, new species

FIGURE 32

Alar expanse 14 mm.

Labial palpus buff; second and third segments light drab on outer side. Antenna drab except some buff scaling toward base; scape buff. Head light ochraceous buff, slightly darker posteriorly. Thorax and forewing grayish fuscous; from base of forewing to termen a slender, buff, longitudinal line; extreme costal edge narrowly yellowish; ground color somewhat mottled but, except for longitudinal line, forewing without distinct markings; cilia grayish fuscous except

apical cilia and spot at end of pale line, buff. Hindwing drab gray; cilia concolorous except for darker basal band. Legs buff overlaid and suffused with drab. Abdomen drab above, paler beneath; posterior tip ocherous white.

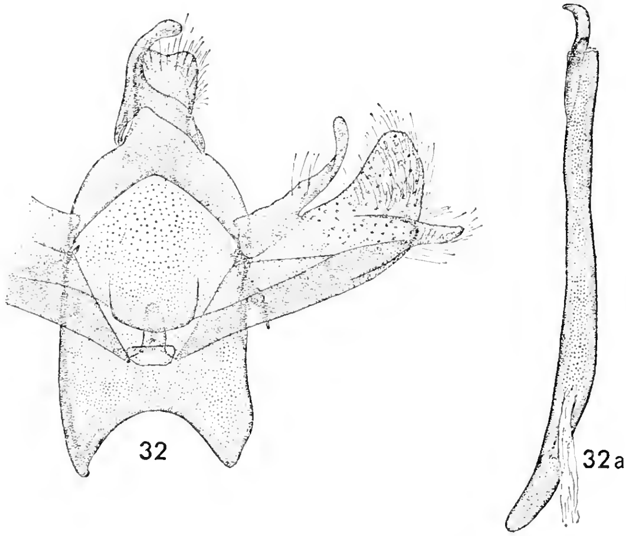


FIGURE 32.—*Juania byssifera*, new species: 32, ventral view of male genitalia with left harpe and aedeagus removed; 32a, aedeagus.

Male genitalia (slide 10709): Costa of harpe terminating in long curved process; cucullus broadly triangular, fleshy; sacculus elongate, triangular, terminating in nearly straight, digitate, sclerotized process. Anterior edge of vinculum deeply excavated. Gnathos stout, curved, asymmetrical, less than twice as long as uncus. Uncus broader posteriorly than basally. Aedeagus moderately long, slender, armed with terminal hook.

Type: Masatierra: El Camote, 600 m. (Jan. 9, 1955).

Described from the unique male type. The clear-cut uninterrupted, longitudinal stripe at once separates *byssifera* from other members of the genus. The genitalia of *byssifera* place it with those species having a vinculum with deeply excavated anterior edge and it is probably nearest *chiloma*. It is separated from *chiloma* by the costal process of harpe, slender extension of sacculus and the longer, more slender aedeagus.

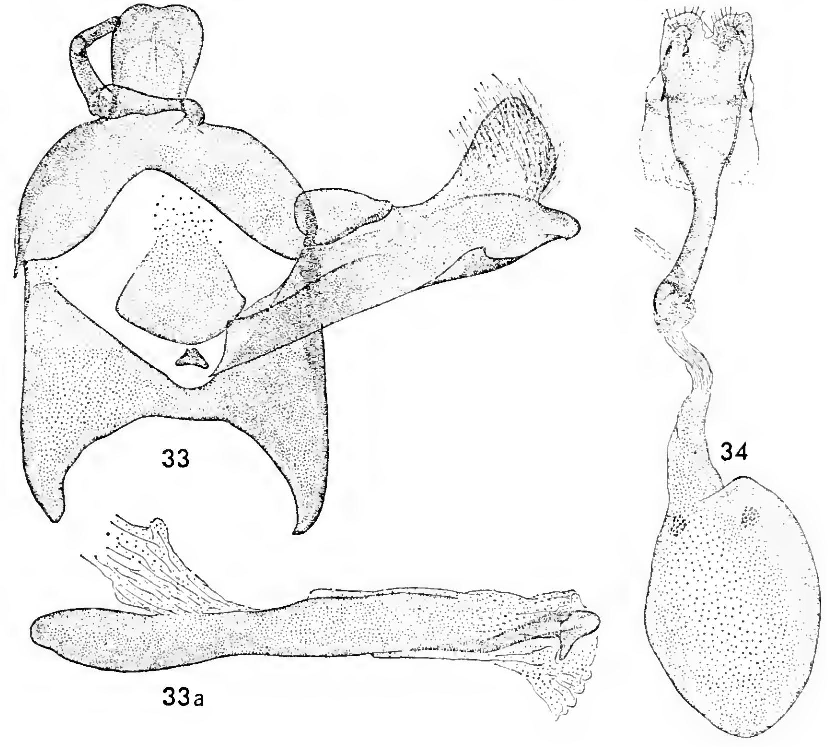
Juania chiloma, new species

FIGURES 33–34

Alar expanse 9–12 mm.

Labial palpus pale buff; second and terminal segments shaded with grayish fuscous on outer side. Head pale buff with slight

infuscation posteriorly. Antenna pale buff shaded with grayish fuscous above and distally. Thorax buff, strongly suffused with grayish fuscous. Forewing ground color buff; from base of costa to middle an elongate fuscous shade broadening toward outer end and extending across wing to fold; basal third of wing, dorsally, fuscous, this area not connected with the costal shade and the two with a longitudinal streak of ground color between; apical third of wing strongly shaded with fuscous but with a narrow band of ground



FIGURES 33–34.—*Juania chiloma*, new species: 33, ventral view of male genitalia with left harpe and aedeagus removed; 33a, aedeagus; 34, ventral view of female genitalia.

color along termen; between the basal and apical dark areas the ground color is suffused grayish fuscous; cilia buff at apex; pale grayish fuscous, with a basal fuscous band, along termen and tornus; entire wing with slight brassy hue. Hindwing grayish fuscous; cilia a shade lighter with a dark subbasal band. Legs buff, lightly suffused with grayish fuscous; tarsi broadly banded with fuscous. Abdomen grayish fuscous; somewhat paler beneath; posterior tip suffused buff.

Male genitalia (slide 10699): Costa strongly sclerotized basally and without any process. Sacculus long and broad with curved,

bluntly pointed terminal process and with ventral edge curled slightly before the terminal process. Gnathos extremely asymmetrical, the long, curved distal process arising on left side. Uncus short, broad, rounded, posterior edge slightly indented. Vinculum very broad, anterior edge deeply excavated. Aedeagus slightly bent and armed with a short, stout terminal thorn.

Female genitalia (slide 10700): Ventral lip of ostium excessively developed, dilated posteriorly and posterior edge excavated (variable). Posterior two-fifths of ductus bursae very strongly sclerotized, round in cross section, remainder of ductus bursae membranous. Inception of ductus seminalis slightly anterior to sclerotized part of ductus bursae.

Type: Masatierra: Villagra (Feb. 22, 1951).

Described from the type female, one male paratype (same data as type) and one male and three female paratypes as follows: Masatierra: Cerro Alto, 600 m., 2 ♀♀ (Feb. 1, 1952); Picacho Central, 600 m., ♀ (Feb. 4, 1952); Quebrada la Laura, ♂ (Mar. 1, 1951).

In type of male genitalia reminiscent of *Fernandocrambus fuscus*. In general appearance *chiloma* is more like *imitator* than any of the other species of this genus. From *imitator*, this species can be separated easily by the absence of a costal process of the harpe and the enormous development of the ventral lip of the ostium.

Juania imperfecta, new species

FIGURE 35

Alar expanse 18 mm. (estimated; apices of both forewings missing).

Labial palpus clay color; first and second segments buff on inner side. Antenna grayish fuscous, with scattered clay-colored scales; scape clay color. Head, thorax, and ground color of forewing clay color; posterior tip of tegula and posterior end of thorax slightly lighter than ground color; from base of wing to end of cell a yellowish buff, longitudinal streak broadens and darkens, merging with the ground color toward termen; from the longitudinal streak to costa wing shaded dark brown, this color fading toward apex; cilia (at tornus) gray. Hindwing gray; cilia pale gray with a dark basal band. Legs buff, strongly overlaid and suffused with grayish fuscous. Abdomen grayish fuscous, paler beneath.

Male genitalia (slide 10649): Harpe moderately broad; costa short, strongly sclerotized, arched; cucullus triangular with broad base; sacculus wide, strongly sclerotized, cupped, bluntly rounded, apex curved ventrad. Anellus a broad, lightly sclerotized plate. Gnathos symmetrical, terminating in a short point. Uncus broad basally, pointed, about two-thirds the length of gnathos. Vinculum

narrowed anteriorly, terminating in two curved points. Aedeagus straight, armed with short, sharp, apical hook.

Type: Masatierra: El Camote, 600 m. (Mar. 17, 1951).

Described from the unique male type.

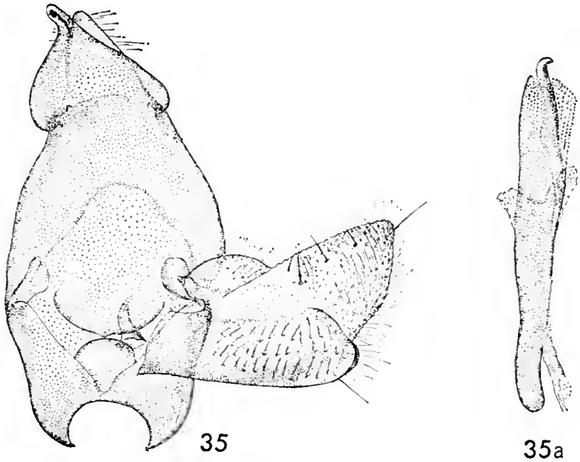


FIGURE 35.—*Juania imperfecta*, new species: 35, ventral view of male genitalia with left harpe and aedeagus removed; 35a, aedeagus.

Despite the damage to the forewings the species is so distinct it merits description. This species also falls in the *chiloma* group but can be distinguished from the others primarily by its symmetrical gnathos. In pattern *imperfecta* somewhat resembles *byssifera*, but *imperfecta* is a larger insect and the median longitudinal streak does not retain its linear form all the way to termen as in *byssifera*.

Juania imitator, new species

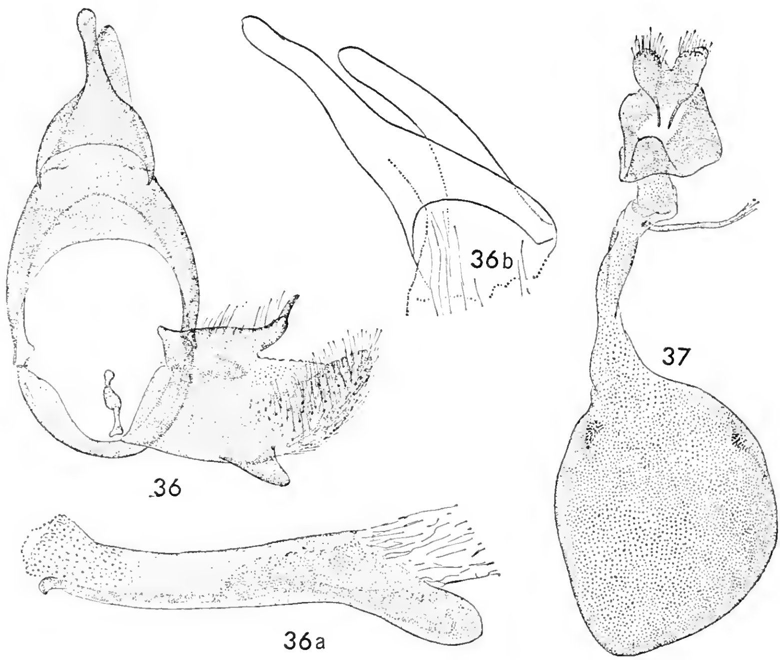
FIGURES 36–37

Alar expanse 11–12 mm.

Labial palpus ivory; second and third segments suffused olive drab on outer side. Antenna olive drab. Head light ochraceous buff except olive-drab frons. Thorax olive drab with light ochraceous buff mixed, the latter, in some specimens, to the almost total exclusion of the darker color. Forewing olive drab; from base to termen a central, longitudinal, pale ochraceous-buff line interrupted at slightly beyond middle, and again before termen, by bars of the ground color; the subterminal bar extended obliquely to apical third of costa and to tornus; the entire wing surface brassy hued; cilia light olive drab. Hindwing light grayish fuscous, darker toward termen and apex; cilia lighter with a dark basal band. Legs pale buff suffused with fuscous. Abdomen olive drab above, paler beneath.

Male genitalia (slides 10695, 10698): Costal arm of harpe curved, sharply pointed; apex of cucullus rounded; terminal process of sacculus short, bluntly pointed. Uncus narrow. Gnathos less than twice the length of uncus. Aedeagus armed with a short, stout hook.

Female genitalia (slide 10696): Genital plate strongly sclerotized, narrowed at ostium. Ventral lip of ostium short, evenly rounded. Ductus bursae sclerotized for short distance before ostium. Inception of ductus seminalis at junction of membranous and sclerotized parts of ductus bursae.



FIGURES 36–37.—*Juania imitator*, new species: 36, ventral view of male genitalia with left harpe and aedeagus removed; 36a, aedeagus; 36b, ventrolateral outline of uncus and gnathos; 37, ventral view of female genitalia.

Type: Masafuera: Quebrada de las Casas (Jan. 16, 1952).

Described from the type male, 5 ♂♂ and one ♂ paratypes all from the same locality with same date.

Superficially *imitator* resembles a small *Crambus* and, indeed, if it were not for the venation, one would place it there. At a casual glance *imitator* might be mistaken for *chiloma* from which it is easily distinguished by the longitudinal, interrupted pale streak of forewing which the latter lacks. In genitalia *imitator* can be distinguished from *chiloma* by the presence of a costal process the latter lacks and by the absence of widely separated points of vinculum. The enormous

ventral lip of ostium of *chiloma,* absent in *imitator,* distinguishes the two at once.

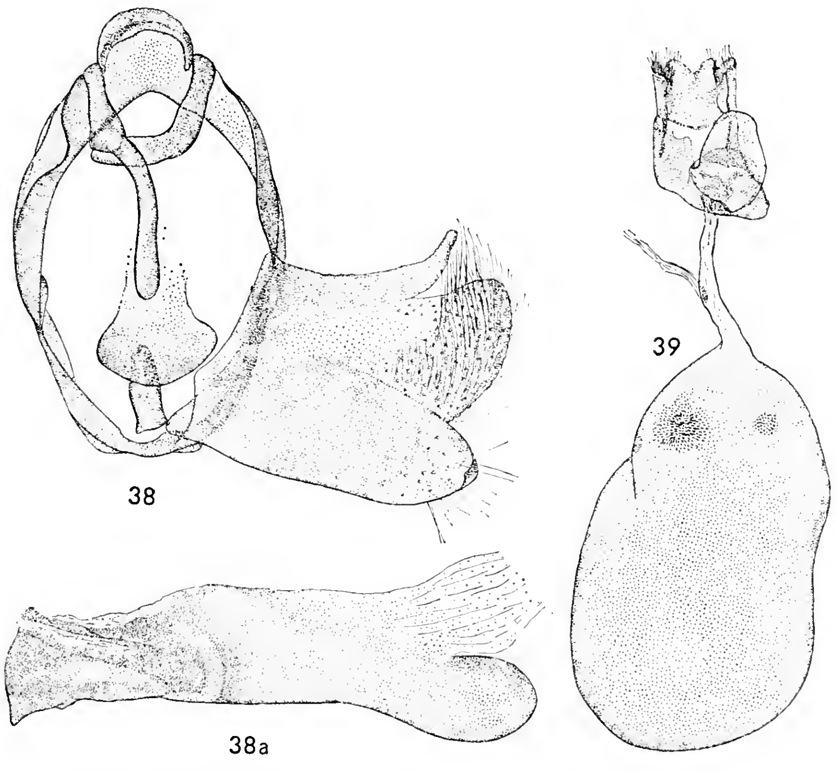
With the type series, but not as part of it, I associate a female from Masafuera, Quebrada de la Calavera (Jan. 15, 1952). This specimen measures 14 mm. in alar expanse and shows slight differences in the size and shape of the ventral lip of ostium, which is narrower and proportionately longer than in typical *imitator;* but the markings are the same and more material, including males, is needed to prove or disprove the correctness of the association.

Juania glareola, new species

Figures 38–39

Alar expanse 9.5–11 mm.

Labial palpus buff; second segment overlaid with grayish fuscous on outer side except ventrally; third segment almost wholly grayish fuscous. Antenna grayish fuscous. Head, thorax, and ground color



Figures 38–39.—*Juania glareola,* new species: 38, ventral view of male genitalia with left harpe and aedeagus removed; 38a, aedeagus; 39, ventral view of female genitalia.

of forewing drab mixed with gray; forewing with indistinct pale longitudinal streak from base to slightly below apex; dorsum and apex shaded with fuscous; apical cilia whitish and confluent with pale longitudinal streak, remainder light grayish fuscous. Hindwing grayish fuscous, paler basally; cilia grayish with darker basal band. Legs drab; tarsi with indistinct pale annulations. Abdomen grayish fuscous, somewhat lighter beneath.

Male genitalia (slide 10710): Harpe broad; costa with short, flattened terminal process; cucullus subtriangular, outer edge strongly curved; sacculus broad, heavily sclerotized and terminating in a broad, bluntly pointed, short process. Gnathos asymmetrical, twisted, more than twice the length of uncus. Uncus almost as wide as long, apex rounded. Aedeagus stout with apical, beaked process.

Female genitalia (slide 10702): Ostium transverse, oval, periphery strongly sclerotized; ventral lip of ostium about as broad as long and posterior edge rounded. Ductus bursae membranous. Inception of ductus seminalis slightly posterior to junction of ductus bursae and bursa copulatrix.

Type: Masatierra: Salsipuedes, 400 m. (Mar. 5, 1951).

Described from the type male and one female paratype with same data. A nondescript insect with scarcely any distinctive superficial features. The longitudinal pale streak is ill defined (more clearly so in the worn female) and best indicated by the whitish terminal spot. The male genitalia suggest a close relationship to *chiloma*. In both species the uncus is very short and the gnathos is asymmetrical and distorted but *glareola* can be distinguished from *chiloma* by the presence of a costal process on harpe, a broader, bluntly pointed sacculus, and the beaked apex of the aedeagus. The females do not exhibit this close relationship. The enormous ventral lip of the ostium of *chiloma* and the strongly sclerotized posterior section of ductus bursae immediately separate *chiloma* from *glareola*.

Juania loxia, new species

FIGURE 40

Alar expanse 15 mm.

Labial palpus sordid white; second segment overlaid with grayish fuscous on outer side; terminal segment wholly grayish fuscous. Antenna and head blackish fuscous, the latter with some light scaling on crown. Thorax and ground color of forewing blackish fuscous; posterior edge of collar, distal end of tegula and posterior end of thorax sordid white; costal edge of forewing grayish; at basal fifth, beginning inside costa, an outwardly oblique, rectangular sordid-white patch extends to dorsum; on dorsum, inside light patch, a light-brown

spot; from apical sixth of costa an irregular, sordid-white line, parallel to termen, extends to tornus; between this light line and termen, in dorsal half, some light-brown shading; cilia gray; underside of costa with a pronounced white spot. Hindwing light fuscous; cilia concolorous but with a grayish cast and with a dark subbasal line. Legs grayish fuscous with white bands at ends of tibiae and tarsi. Abdomen grayish fuscous.

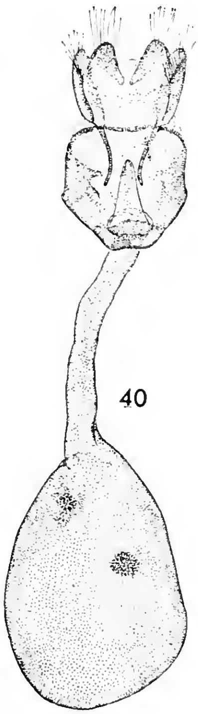


FIGURE 40.—*Juania loxia*, new species: ventral view of female genitalia.

Female genitalia (slide 10662): Area posterior to ostium membranous; ventral lip of ostium narrowly triangular and weakly sclerotized. Anterior apophyses absent. Ductus bursae membranous. Inception of ductus seminalis in posterior third of ductus bursae.

Type: Masatierra: Picacho Central, 600 m. (Feb. 4, 1952).

Described from the unique type female. The coloring of this species is striking because the dark, contrasting ground color is set off by the light basal area and subterminal line forming, roughly, a conspicuous triangle. In genitalia *loxia* is nearest *paraloxia* as indicated by the ventral lip of the ostium and the absence of the anterior apophyses.

***Juania paraloxia*, new species**

FIGURE 41

Alar expanse 14 mm.

Labial palpus white; second segment with slight grayish-fuscous shading distally on outer side; third segment almost wholly grayish fuscous. Antenna grayish fuscous except for a white line ventrally in basal half. Thorax fuscous; tegula and collar grayish fuscous with white scaling along edges; posterior end of thorax whitish. Forewing ground color fuscous, interrupted by an outwardly oblique

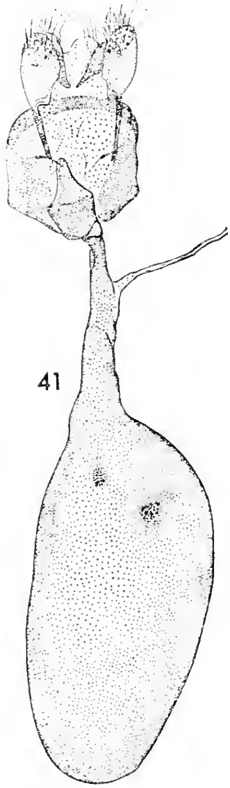


FIGURE 41.—*Juania paraloxia*, new species: ventral view of female genitalia.

whitish patch from inside costa at basal fifth to dorsum; a subterminal, oblique whitish line from apical sixth of costa to tornus and a large whitish ovate spot between the other two white markings; some light-brown shading, between subterminal light line and termen, followed by three ill-defined pale areas before cilia; cilia gray; underside with an elongate white, preapical spot on costa. Hindwing grayish fuscous; cilia concolorous with darker basal line. Legs light grayish

fuscous with pale annulations at ends of tibiae and tarsi. Abdomen grayish fuscous with whitish scaling beneath.

Female genitalia (slide 10384): Genital plate broad; area posterior to ostium membranous. Ventral lip of ostium narrowly triangular but broadened abruptly at base; weakly sclerotized. Anterior apophyses absent. Ductus bursae membranous except extreme posterior portion. Inception of ductus seminalis slightly before posterior third.

Type: Masatierra: El Camote, 600 m. (Mar. 17, 1951).

Described from the unique female type. The type specimen lacks the right forewing and is otherwise in only fair condition but is a striking insect closely related to *loxia*. The chief point of external difference between *paraloxia* and *loxia* is the presence of the large ovate light spot in the central area of the forewing of the former and absence in the latter. The genital plate of *paraloxia* is broader than that of *loxia* and the ventral lip of ostium is much more slender in *loxia* than in *paraloxia*.

Juania magnifica, new species

FIGURE 42

Alar expanse 40–43 mm.

Labial palpus white; basal segment with a pale grayish-fuscous spot outwardly; second segment with longitudinal, oblique, grayish-fuscous band from base, dorsally, to apex ventrally; third segment suffused grayish fuscous. Antenna, scape white with fuscous spot dorsally, remainder sordid whitish suffused grayish fuscous. Head white suffused grayish fuscous anteriorly and laterally. Thorax and ground color of forewing white, the former with pale grayish-fuscous mottling; extreme base of costa narrowly blackish fuscous; from slightly before middle of costa, inwardly along vein 12, then outwardly to middle of dorsum, an irregular fuscous transverse line; from costa, at apical fourth, an outwardly oblique fuscous, broken line extends to vein 6, then continues to tornus nearly parallel to termen; between the two transverse lines a white diamond-shaped spot narrowly edged with fuscous; termen marked with six blackish-fuscous spots at the ends of the veins; remainder of wing irregularly irrorate or lightly suffused with grayish fuscous, paler basally; cilia paler than wing, apical cilia white. Legs white, suffused and spotted with fuscous; markings of hindleg confined to grayish-fuscous tarsal spots. Abdomen grayish fuscous above, paler beneath.

Female genitalia (slide 10383): The unusually large spatulate process, arising on the ventroanterior edge of the ostium and extending almost to the tip of the ovipositor, is an extreme development of similar processes found in other species of Crambidae.

Type: Masatierra: Plazoleta del Yunque (Jan. 2, 1952).

Described from the female type and two female paratypes as follows: Masatierra, ♀, same data as types: ♀, Bahía Cumberland (Mar. 4, 1951).

This is the largest known species of the genus and is a striking insect. The male is not known.

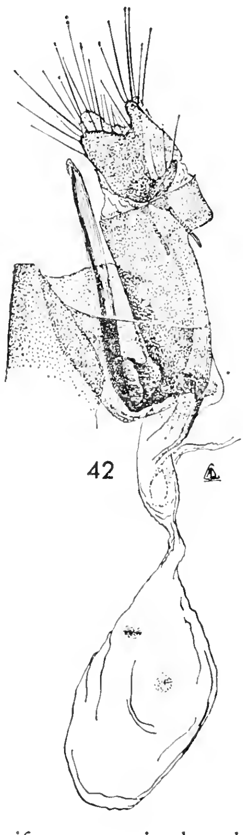


FIGURE 42.—*Juania magnifica*, new species: lateral view of female genitalia.

Family Pyralidae

Subfamily Scopariinae

Genus *Scoparia* Haworth

The species of *Scoparia* are separated by the following key:

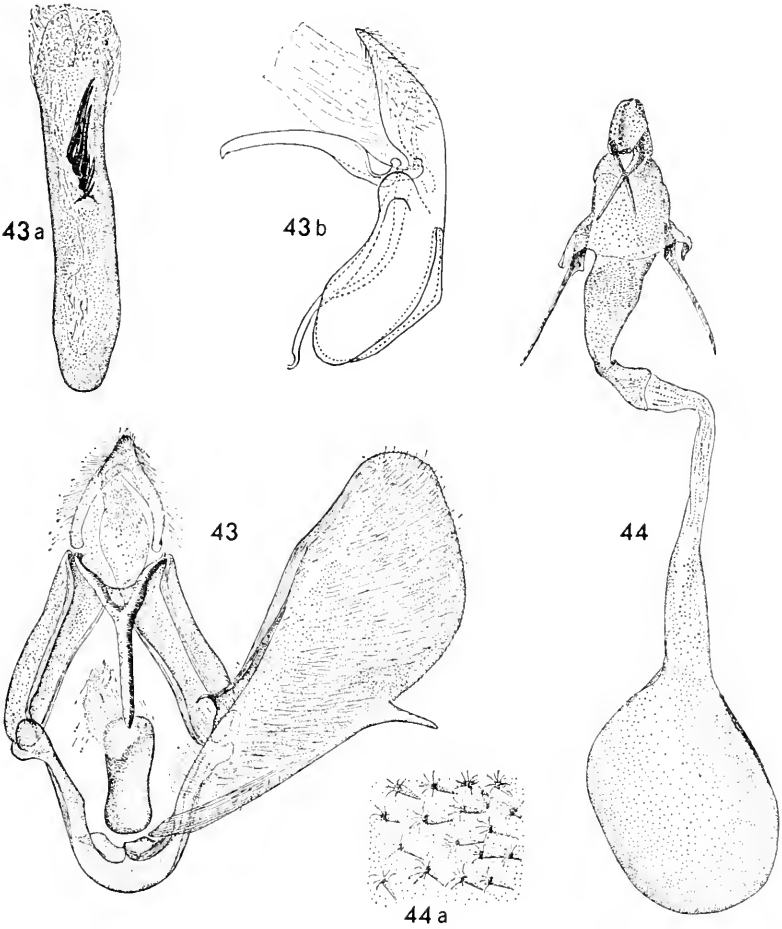
1. Labial palpus white or sordid white 2
   Labial palpus cinnamon buff, overlaid with fuscous on outer side. **pyraustoides**, new species
2. Alar expanse 22 mm. **dela**, new species
   Alar expanse 26 mm., or more . . . . **matuta**, new species

Scoparia matuta, new species

Figures 43–44

Alar expanse ♂, 28–31 mm., ♀, 26 mm.

Labial palpus white; outer side of second segment buffy brown with dark spot near base. Head white, mixed with pale brown; face almost wholly buffy brown. Antenna light brown with fuscous spots above. Thorax and ground color of forewing buffy brown; tegula fuscous on basal, inner half; metathorax with some white scaling; at apical fourth an irregular white line outwardly oblique to vein 6, then inwardly oblique to dorsum before tornus; the white line is preceded



Figures 43–44.—*Scoparia matuta*, new species: 43, ventral view of male genitalia with left harpe and aedeagus removed; 43a, aedeagus; 43b, lateral outline of tegumen, uncus and gnathos; 44, ventral view of female genitalia; 44a, detail of wall of bursa copulatrix.

by fuscous shading; surface of forewing irregularly marked with fuscous and white streaks; around termen a series of slender fuscous dashes along veins; cilia pale buffy brown mixed with fuscous and white scales. Hindwing pale yellowish gray shaded with fuscous along outer margin; cilia pale grayish with whitish median, and grayish-fuscous basal lines. Legs white overlaid and shaded with buffy brown and pale brown. Abdomen pale pearly gray with fuscous shading laterally and slight fuscous irroration ventrally.

Male genitalia (slide 10640): The vesica is armed with three long slightly curved cornuti at the base of which is a cluster of small fine ones.

Female genitalia (slide 10674): The female genitalia are somewhat atypical, the signum consisting of a very slender sclerotized ridge with some sclerotization around it, rather than a scobinate patch or a few spines. Ductus bursae sclerotized in posterior third, flattened and broad at ostium.

Type: Masafuera: La Correspondencia, 1150 m.

Described from the male type, 11 male and one female paratypes all from the type locality. (Jan. 18, 1955 to Feb. 15, 1955.)

The female of this species, although marked similarly, is strikingly different from the males in general appearance. It is not only smaller than the males but the wings are much narrower with the costal and dorsal margins nearly parallel. The apices of both fore- and hind-wings are produced and acutely pointed and the terminal margins are concave. This sort of dimorphism is not uncommon in insular areas but this is the only example I know from these islands.

Scoparia dela, new species

FIGURE 45

Alar expanse 22 mm.

Labial palpus sordid white; second segment strongly overlaid with fuscous on outer side and with pale brownish on lower half of inner surface; third segment ground color almost wholly obscured by pale brownish suffusion. Head white mixed with pale brownish scales; antenna with scape whitish, remainder pale brown with whitish scales at ends of segments. Thorax and ground color of forewing sordid white; tegula with fuscous base and with pale yellowish scales mixed with the white ground posteriorly; extreme edge of costa, from base to two-fifths, blackish fuscous; from base of costa to fold an outwardly oblique blackish-fuscous bar; from basal two-fifths of costa an outwardly oblique, transverse, blackish-fuscous line extends to dorsum; from this line two spurs of similar color extend into cell and

along lower edge of cell to vein 2; on costa, slightly beyond middle and well before apex, two blackish-fuscous spots; at end of cell a large, bilobed spot of same color; around termen, between veins, a series of short, blackish-fuscous dashes; entire surface of wing covered with scattered blackish-fuscous scales; cilia white spotted with fuscous. Hindwing shining yellowish white suffused with pale fuscous and with an ill-defined, subterminal fuscous band; cilia whitish with slight infuscation. Legs whitish overlaid and banded with fuscous. Abdomen sordid whitish somewhat infuscated.

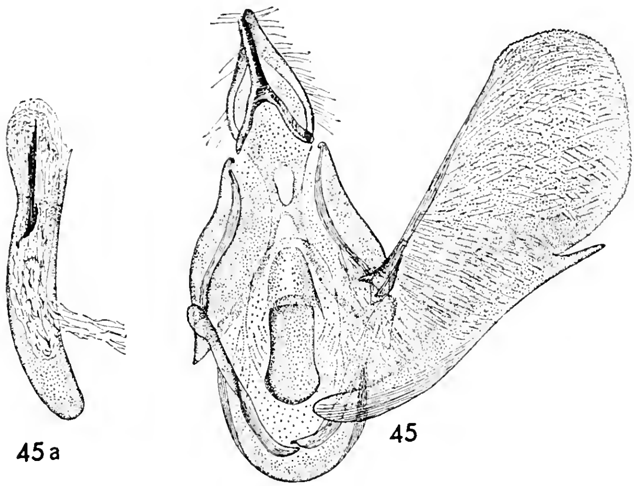


FIGURE 45.—*Scoparia dela*, new species: 45, ventral view of male genitalia with left harpe and aedeagus removed; 45a, aedeagus.

Male genitalia (slide 10679): Vesica armed with a group of four long, slender cornuti arising from a common base, and a single, weak cornutus dorsal to the group. Gnathos slender, about as long as uncus.

Type: Masafuera: La Correspondencia, 1150 m. (Jan. 28, 1955).

Described from the unique type male. A distinct species resembling North American forms. The genitalia are typical. *S. dela* can be distinguished from *matuta* and *pyraustoides*, besides by the coloration and markings, by the short gnathos which is equal in length to the uncus. In the other two species the gnathos is appreciably longer than the uncus. This species is further distinguished from *pyraustoides* by the presence of cornuti which *pyraustoides* lacks; from *matuta* by the absence of the cluster of small, weak cornuti at the base of the group of larger ones.

Scoparia pyraustoides, new species

Figure 46

Alar expanse 25–28 mm.

Labial palpus light cinnamon buff, outer side overlaid with fuscous. Head and antenna light cinnamon buff, the latter with tiny fuscous spots at the ends of the segments. Thorax and ground color of forewing light cinnamon buff; tegula fuscous at base and thorax with some dark suffusion; costa with extreme base fuscous and with some dark suffusion about middle; from basal quarter of costa to basal third of dorsum an irregular, indistinct, outwardly oblique fuscous line followed by a fuscous spot in cell; at outer end of cell a large, quadrate fuscous blotch; from outer fourth of costa an indistinct, fuscous, transverse line outwardly oblique to vein 6, thence inwardly

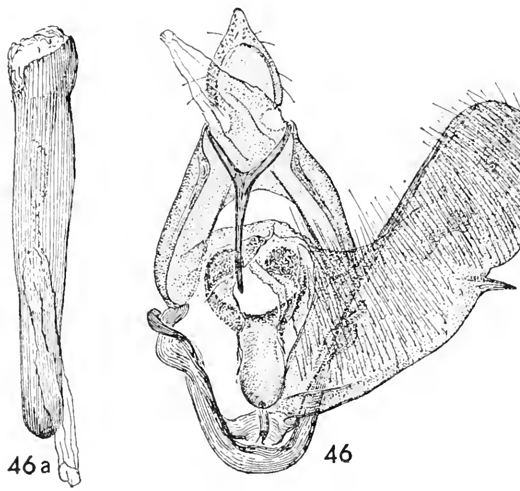


Figure 46.—*Scoparia pyraustoides*, new species: 46, ventral view of male genitalia with left harpe and aedeagus removed; 46a, aedeagus.

oblique to dorsum slightly before tornus; this transverse line accentuated where it crosses veins; between the outer transverse line and termen some dark suffusion; cilia cinnamon buff with a narrow fuscous basal line. Hindwing ocherous white, shading to cinnamon buff at apex and around margin; cilia cinnamon buff with scattered fuscous scales mixed. Legs whitish ocherous; femora and tibiae overlaid, and tarsi spotted, with fuscous. Abdomen whitish ocherous, somewhat darker beneath, and with a ventrolateral line of fuscous spots.

Male genitalia (slide 10398): Vesica without cornuti (at least in type).

Type: Masatierra: El Yunque, 515 m. (Feb. 10, 1952).

Described from the male type and two male paratypes as follows: Type male and one male paratype with same data; one male paratype, Masatierra: Alto Francés, 500 m. (Jan. 16, 1955).

Superficially this species looks like a typical pyraustid. Apparently *pyraustoides* is nearest *matuta* from which it can be distinguished by the absence of cornuti.

Subfamily Pyraustinae

Genus *Oeobia* Hübner

Oeobia ragonotii (Butler), new combination

FIGURES 47–48

Mella ragonotii Butler, 1883, Trans. Ent. Soc. London, 1883, p. 59.
Scoparia ragonoti (Butler), Hampson, 1897, Trans. Ent. Soc. London, 1897, p. 233.
Scoparia ragonoti (Butler), Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 265.

Alar expanse 19–25 mm.

Male genitalia (slide 10262): Vesica armed with a single, small cornutus.

Female genitalia (slide 10264): Signa consisting of a diamond-shaped plate and a curved, spined plate at the junction of the ductus bursae and bursa copulatrix.

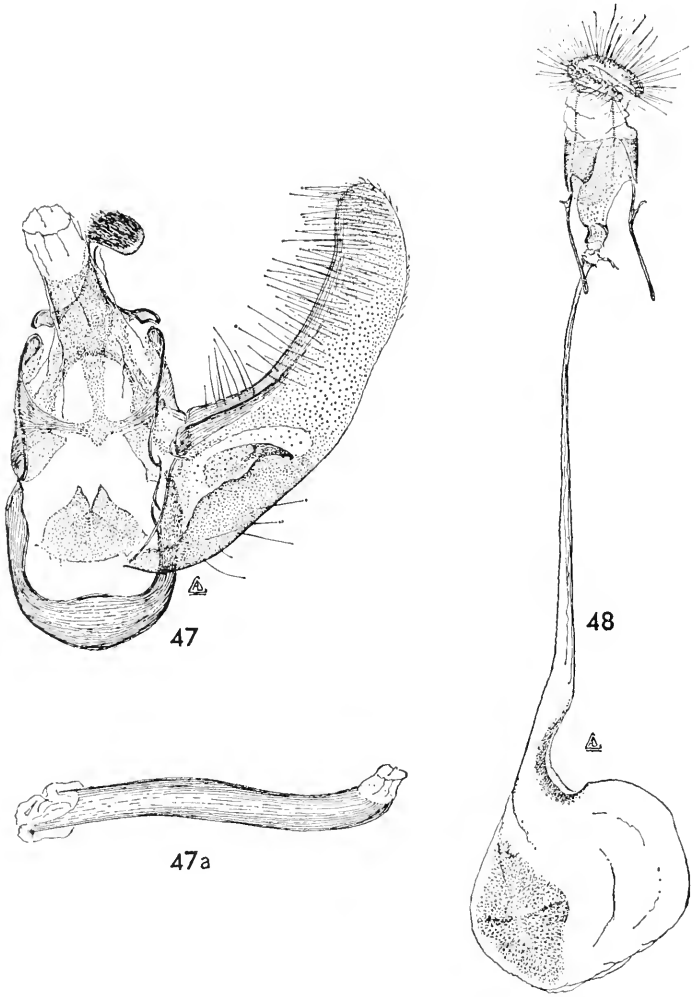
Type: British Museum (Natural History).

Type locality: Valparaiso, Chile.

Distribution: Masatierra: Bahía Cumberland ♂, 6 ♀♀ (Mar. 4, 1951, Jan. 3–4, 1952, Jan. 14, 1955); Plazoleta del Yunque, ♂, 2 ♀♀ (Jan. 2–3, 1952, Feb. 20, 1951); Masafuera: Quebrada de las Casas, 4♂♂, 2 ♀♀ (Jan. 14–19, 1952, Feb. 21, 1955); Santa Clara: El Corral, 3♂♂, 3 ♀♀ (Jan. 6, 1952).

This is one of the few species found widespread in the islands. It is a mainland form, described from Valparaiso, and is probably more widely distributed than present records indicate.

Certainly *ragonotii* is misplaced in *Scoparia* and I am, therefore, transferring it out of that genus. In placing it in *Oeobia* I do so with some misgiving but the species is not a scopariine; it is a pyraustine, hence this present assignment. The fact remains, however, that the venation does not agree with most species assigned to *Oeobia* but the male genitalia indicate that *ragonotii* belongs in this general group. The female genitalia are atypical for the genus. In general appearance *ragonotii* is strikingly similar to *Oeobia crambialis* (Grote) though it is a smaller insect.



Figures 47–48.—*Oeobia ragonotii* (Butler): 47, ventral view of male genitalia with left harpe and aedeagus removed; 47a, aedeagus; 48, ventral view of female genitalia.

Giorgia, new genus

Type-species: *Giorgia crena*, new species.

Antenna fasciculate and finely ciliate in male, filiform in female. Labial palpus upturned; second segment roughened in front; third segment one-half length of second, cylindrical, smooth. Maxillary palpus dilated with scales. Head roughened posteriorly; frons rounded. Forewing smooth, moderately narrow, 12 veins; vein 2 from well before angle; 3, 4, and 5 about equidistant at base, divergent; 6 nearly twice as far from 7 as 7 is from 8; 7 to costa; 8 and 9 long

stalked, approximate to 10, from upper angle of cell; 11 short, from near angle of cell. Hindwing without pecten on median vein; with 7 veins; 2 remote; 3 well before angle; 4 and 5 approximate; 7 and 8 united; 6 approximate and joined to 7 and 8 by short crossvein. Both fore- and hindwings with termen emarginate below apex. Inner and outer tibial spurs of about equal length.

Male genitalia with simple harpe. Gnathos and uncus present. Anellus well developed. Vesica armed.

Female genitalia with signum present, anterior.

In Hampson's key (1898) this genus runs to *Sufetula* Walker and, in fact, resembles it superficially. In *Sufetula*, however, veins 7 and 8 of forewing both go to termen while in *Giorgia* both go to costa. In the hindwing of *Giorgia* veins 7 and 8 are coincident but in *Sufetula* they are stalked.

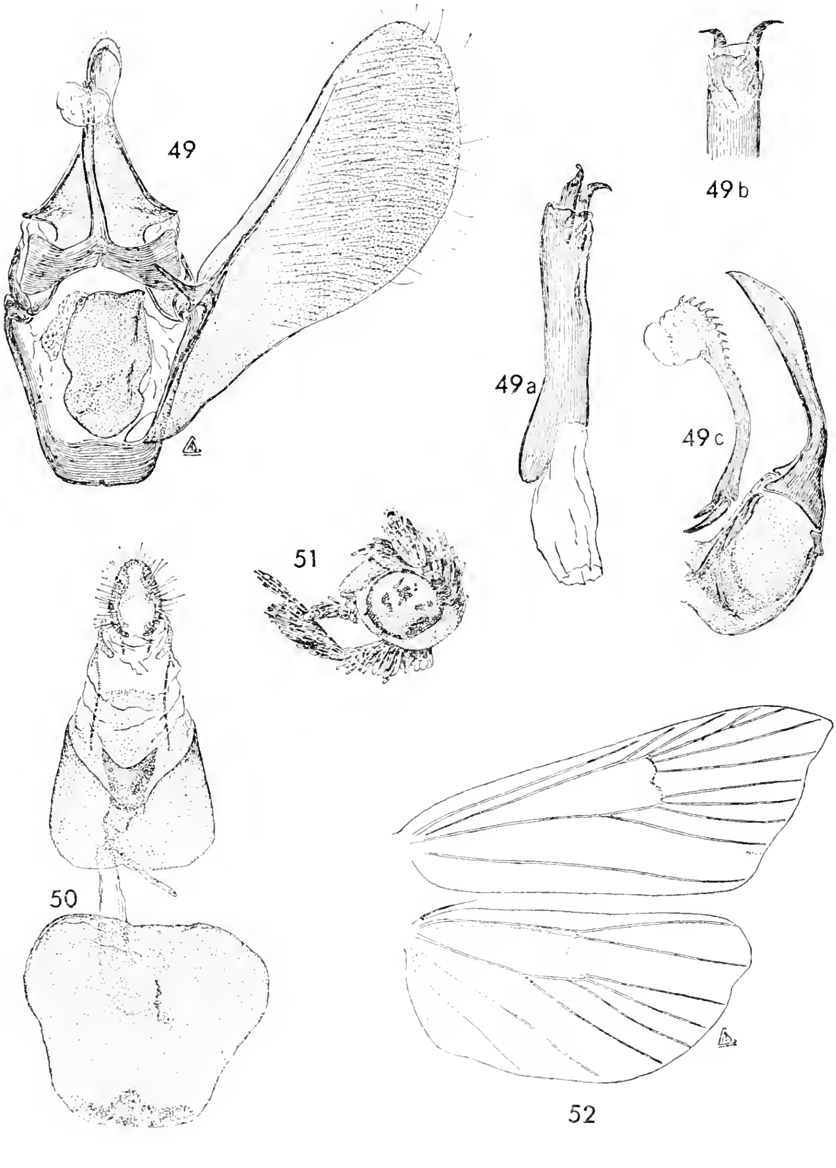
In placing this rather singular genus in the Pyraustinae, I do so with some misgiving. The gnathos suggests placement elsewhere but, perhaps, the genus goes as well here as elsewhere. At best the genus is aberrant.

Giorgia crena, new species

FIGURES 49–52

Alar expanse 9–13 mm.

Labial palpus cartridge buff except second segment fuscous on outer surface and third segment wholly fuscous. Antenna grayish, cilia silvery, a spot of black scales at end of each segment. Head pale gray; face cartridge buff. Thorax and ground color of forewing cream buff, the ground color largely obscured by dark markings; thorax finely and closely irrorate with fuscous; basal sixth of forewing fuscous, the ground color showing through faintly; basal patch followed by a band of ground color irrorate with fuscous; beyond this a broad, outwardly oblique, fuscous blotch extending to middle of wing and joined to a narrower, inwardly oblique sayal brown spot, the latter joined to a narrow, irrorate fuscous area extending to dorsum; beyond the above band of dark color a broad band of ground color crossed by two irregular, slender, fuscous transverse lines, each broadened on costa and dorsum; from apical third of costa, to tornus, a broad, dark band consisting of a fuscous blotch on costa and a similar one above tornus; between the two fuscous blotches, and joined to them, a sayal brown spot containing two longitudinal fuscous streaks; on tornus a narrow fuscous streak with a sayal brown spot between it and the fuscous blotch above tornus; between this bicolored, dark, transverse fascia and termen, cream buff, shading to grayish fuscous on termen; cilia cream buff with grayish-fuscous spots at apex, midtermen and tornus; underside drab, with a broad,



FIGURES 49–52.—*Giorgia crena*, new genus and new species: 49, ventral view of male genitalia with left harpe and aedeagus removed; 49a, aedeagus; 49b, terminal armature of aedeagus; 49c, lateral aspect of tegumen, uncus and gnathos; 50, ventral view of female genitalia; 51, lateral aspect of head to show palpus; 52, venation of right wings.

fuscous subterminal band preceded on costa by a cream-buff spot. Hindwing drab crossed by four indistinct, suffused, fuscous bands, alternating with cream buff, in dorsal half of wing, the outer band represented by a conspicuous fuscous blotch; cilia cream buff with conspicuous fuscous basal band at apex and along termen; underside with three well-defined grayish-fuscous bands. Legs grayish fuscous except buff outer side of first femur and narrow, suffused, annulations on all tarsi. Abdomen fuscous with narrow, pale, grayish annulations; first three or four segments white beneath; on third segment, dorsally a conspicuous buff spot; anal tuft buff.

Male genitalia (slides 10245, 10363): Harpe simple, narrow at base and widened toward cucullus. Uncus as long as gnathos, dilated toward apex and sharply pointed; gnathos slender, slightly curved and armed with a series of sawlike teeth on posterior edge. Anellus an elongate sclerotized plate, slightly convex ventrally. Aedeagus short, stout, armed with two strong hooks. Vinculum a narrow band.

Female genitalia (slides 10249, 10364): Ostium moderately broad, posterior edge concave. Ductus bursae membranous except for a short distance before ostium. Inception of ductus seminalis at junction of membranous and sclerotized parts of ductus bursae. Bursa copulatrix, pear shaped, broader posteriorly than anteriorly; signum a four-pointed, scobinate plate (in one example the ventral point, nearest observer, is produced more than a third the length of bursa copulatrix).

Type: Masafuera: Inocentes Bajos, 1000 m. (Jan. 27, 1952).

Food plant: *Diksonia berteriana* (Colla) Hooker.

Described from the type male and 30 ♂♂ and 6 ♀♀ paratypes as follows: Masafuera: La Correspondencia, 1300 m., 2 ♂♂ (Jan. 21, 1952); Inocentes Bajos, 1000 m., 13 ♂♂ (Jan. 27, 1952); Quebrada de la Calavera, 350 m., 8 ♂♂ (Jan. 15, 1952, Jan. 23, 1955); Quebrada de las Casas, ♂, ♀ (Jan. 19, 1952); Quebrada de las Vacas, ♂ (Jan. 17, 1952). Masatierra: Bahía Cumberland, 5 ♂♂, 5 ♀♀ (Feb. 15–Mar. 4, 1951, Mar. 18, 1955).

As indicated elsewhere in this paper, there are very few of the species that are represented on more than one of the islands of this group. In the case of *crena,* however, there can be no doubt about the identity of the populations found on Masatierra and Masafuera. The examples from Masafuera all, apparently, from relatively high altitudes, show a constancy of coloration not found in the Masatierra specimens. The latter, all from the one locality at low altitude, exhibit considerable variation among themselves and all are different from the Masafuera group. In addition to the brown spots indicated in the description, there is a spot of similar color at the end of cell of

forewing in all of the Bahía Cumberland examples: one specimen has the forewing almost entirely sayal brown with fuscous prominent on only the basal half of costa, the apex and in the terminal area. Four of the females show no trace of the pale median band, the entire area being fuscous; in one male the dorsal half of the light transverse band has been similarly replaced with fuscous.

The proportion of sexes is also a matter of interest. In the sample from Masafuera the males outnumber the females by 25 to 1 but in the Masatierra series the sexes are evenly divided. It appears that the date of sampling is a factor here. The Masafuera specimens were taken in January but all of those from Masatierra were caught from mid-February to mid-March.

Genus *Mnesictena* Meyrick

Mnesictena tetragramma, new species

FIGURE 53

Alar expanse 17–18 mm.

Labial palpus cream buff beneath; second segment brick red above the cream-buff lower part; third segment black with a few brick-red scales mixed. Antenna blackish fuscous with a few scattered pale scales in outer half. Head brick red with tawny scales posteriorly. Thorax brick red anteriorly, the remainder blackish fuscous with

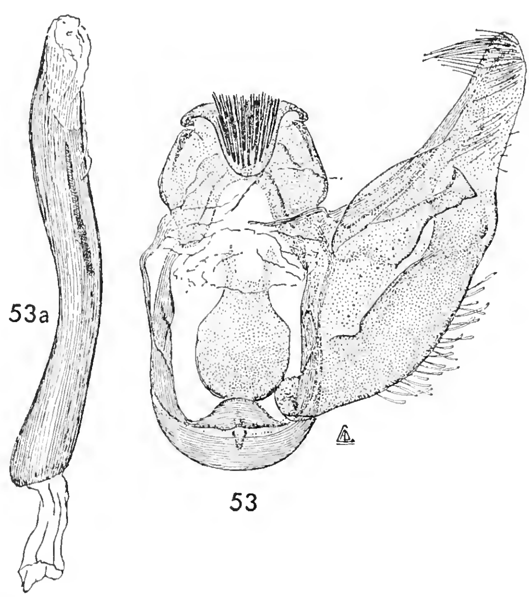


FIGURE 53.—*Mnesictena tetragramma*, new species: 53, ventral view of male genitalia with left harpe and aedeagus removed; 53a, aedeagus.

tawny scales posteriorly; tegula mixed with tawny and reddish scales posteriorly. Forewing fuscous, strongly overlaid with ferruginous; at two-fifths of costa a straight, transverse, ill-defined, fuscous line extends to dorsum at basal third; from apical sixth of costa a transverse, ill-defined line extends to vein 2 as a gently curved arc, along vein 2 to cell, then diagonally to vein 1c, outwardly on 1c, then straight to dorsum at outer two-thirds; in cell, in a straight line, three small white dots preceded and followed by blackish-fuscous scales; on outer half of costa four ocherous-tawny spots alternating with suffused shades of blackish fuscous; on termen seven tiny, ill-defined blackish-fuscous dots; cilia fuscous basally shading to ocherous tawny mixed with cream buff; underside overlaid ferruginous outwardly; costal spots accentuated; a conspicuous black spot at end of cell. Hindwing grayish fuscous; on discocellulars, at bases of veins 6 and 8, a black spot preceded by a whitish area of wing; from apical fourth of costa, paralleling termen, an irregular blackish-fuscous line extends to anal veins; cilia grayish fuscous basally shading to ocherous tawny mixed with cream buff; dark markings of upper surface repeated and accentuated on under surface. Legs ocherous buff overlaid with brick red and suffused basally with fuscous; spurs grayish fuscous. Abdomen grayish fuscous above, buff beneath.

Male genitalia (slide 10399): Harpe broad at base, cucullus tapering, narrow, bluntly pointed; sacculus strongly sclerotized but simple; clasper dilated distally and truncate. Anellus roughly elongate oval, constricted posteriorly. Uncus broad basally, bluntly pointed; posterior surface clothed with long, strong setae. Vinculum U-shaped, narrow. Aedeagus moderately stout, curved; vesica armed with a single long, slender cornutus.

Type: Masatierra: El Yunque, 915 m. (Feb. 10, 1952).

Described from the type male and one male paratype with same data.

In placing this species in the New Zealand genus *Mnesictena*, I do so with reservation. At any rate, *tetragramma* does not belong in any of the described South American genera and, except for having a longer labial palpus, agrees in all respects with Meyrick's genus. This species looks like a smaller and less well-marked example of *Pionea fumipennis* but is, of course, easily distinguished from it.

Genus *Pionea* Guenée

Pionea fumipennis (Warren)

FIGURES 54–55

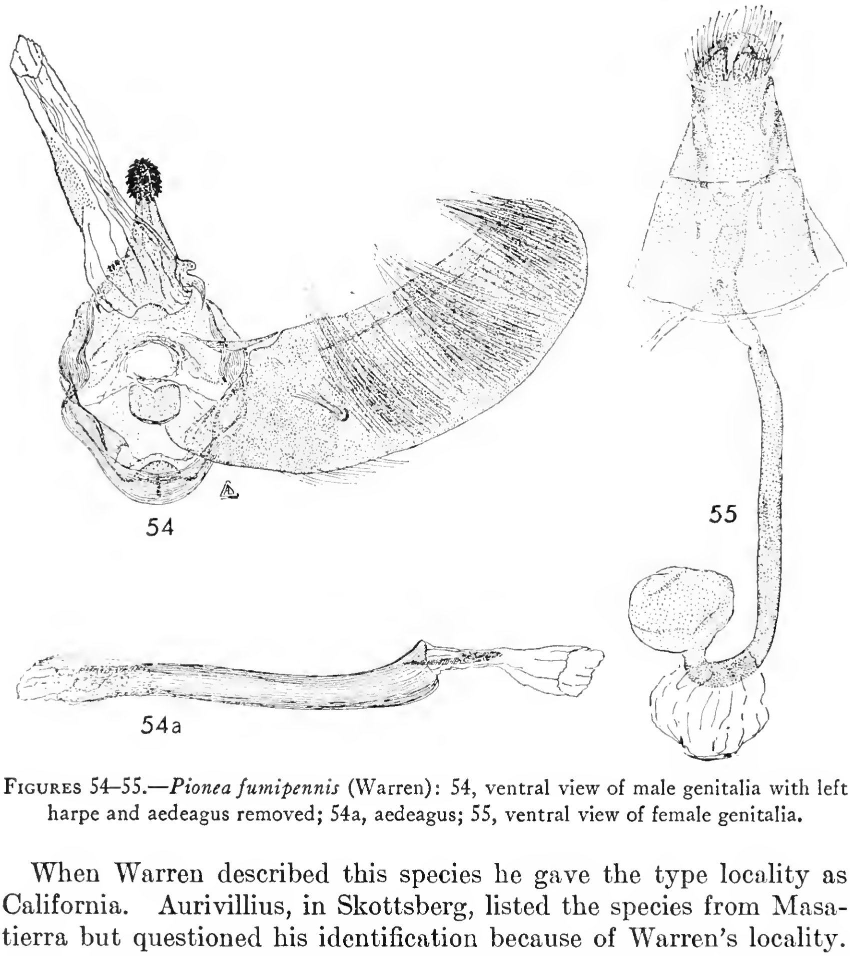
Ebulea fumipennis Warren, 1892, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 392—Hampson, 1899, Proc. Zool. Soc. London, 1899, p. 249.—Aurivillius, 1922,

in Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 266, pl. 11, fig. 16.

Type: British Museum (Natural History).

Type locality: "Juan Fernandez."

Distribution: Masatierra: Villagra ♂ (Feb. 21, 1951); Plazoleta del Yunque, 220 m. ♂ (Jan. 9, 1952); ♂, 8 ♀♀ (Mar. 3, 1955).



FIGURES 54–55.—*Pionea fumipennis* (Warren): 54, ventral view of male genitalia with left harpe and aedeagus removed; 54a, aedeagus; 55, ventral view of female genitalia.

When Warren described this species he gave the type locality as California. Aurivillius, in Skottsberg, listed the species from Masatierra but questioned his identification because of Warren's locality. I have examined Warren's types in the British Museum (Natural History) and have also seen Skottsberg's specimens. There is no question of the identity of the two lots and certainly the material presently at hand is the same. Mr. W. H. T. Tams has written me as follows: "The two specimens of *Pionea fumipennis* (Warren) are certainly labeled 'Juan Fernandez 84–72.' I have looked up the register and find that they were presented by Commander J. J. Walker, R.N., together with 670 other Lepidoptera, 'many rare,' from such

places as Chile, Straits of Magellan, etc., which means that they were caught by J. J. Walker himself. Obviously, Warren's *statement in print is a slip.*" The California record, therefore, is in error and the species should be dropped from our North American lists because the specific identity of the Juan Fernandez material is a certainty.

In this species there is a marked sexual dimorphism characterized by a contrasting pattern in the male and obscure pattern and somber coloring in the female. The conspicuous pale costal spot of the male forewing, repeated on the underside, is obscured and scarcely discernible in the female. On the underside of the female forewing, however, this spot is nearly as pronounced as in the male. The forewing of the female is light brown above, overlaid with vinaceous scales. The ill-defined fuscous markings of the forewing consist of two subcostal spots preceding and following the pale costal spot; a transverse line at one-third, another subterminally, and a patch of scales at the base of wing dorsally.

In all probability *fumipennis* will have to be transferred out of *Pionea* but that must be left to the revisers of the pyraloids. For the present I am leaving the species in *Pionea*. The male and female genitalia are figured from specimens from Masatierra, slides, ♂, 10400 and ♀, 10638.

Genus *Pyrausta* Schrank

Pyrausta louvinia, new species

Figure 56

Alar expanse 18 mm.

Labial palpus white beneath; second and third segments grayish fuscous mixed with pale reddish scales. Antenna grayish fuscous with neutral red scales on scape. Head, thorax, and ground color of forewing neutral red; head with fuscous and gray scales mixed, particularly posteriorly; metathorax with mixed fuscous and pale gray; extreme costa of forewing pale tawny mixed with fuscous basally; from basal fourth of costa a fine, ill-defined black line outwardly oblique to cell, then, at right angles, inwardly oblique to basal fourth of dorsum; remainder of forewing covered with sparse, fine black scales; tornus with suffused blackish shade; cilia grayish fuscous, paler apically and irrorate with reddish scales; underside fuscous with a narrow tawny shade along costa. Hindwing fuscous, paler basally; cilia grayish fuscous, paler apically and mixed with light tawny. Legs grayish fuscous; foreleg overlaid with fuscous on outer side; mid- and hindlegs suffused grayish. Abdomen fuscous with scattered brassy scales on first three segments dorsally; re-

mainder of segments narrowly edged with grayish; first three segments cinereous beneath.

Male genitalia (slide 10402): Clasper a blunt, sclerotized process, directed toward base of harpe; cucullus broadly rounded. Anellus a transverse, rectangular plate, articulated at each posterolateral

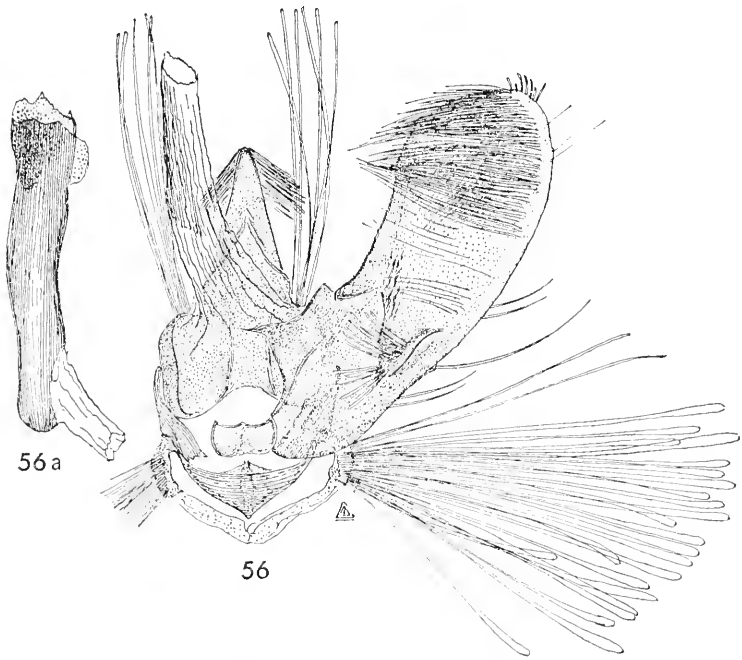


FIGURE 56.—*Pyrausta louvinia*, new species: 56, ventral view of male genitalia with left harpe and aedeagus removed; 56a, aedeagus.

corner with a slender arm of the transtilla. Uncus an elongated triangle. Vinculum narrow with scale-tuft membrane attached. Aedeagus stout, slightly bent; vesica armed with a cluster of fine cornuti.

Type: Masatierra: Miradero de Selkirk, 550 m. (Feb. 15, 1951). Described from the unique male type. Similar in coloring to the Mexican *P. volupialis* Grote, but darker, and lacking the light transverse line of the forewing of that species.

Genus *Loxostege* Hübner

Loxostege oxalis, new species

FIGURE 57

Alar expanse 26 mm.

Labial palpus ochraceous buff; second and third segments with a few red-brown scales. Antenna, head, and thorax ochraceous buff,

head a little lighter posteriorly; anterior part of thorax and tegula with faint brown suffusion. Ground color of forewing shining ochraceous buff suffused over entire surface with tawny; at slightly before middle of wing, starting at cell, an inwardly oblique, ochraceous-tawny, transverse line extends almost to dorsum at basal two-fifths;

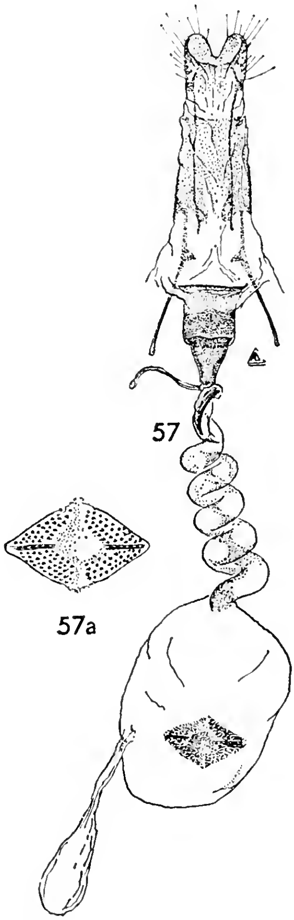


FIGURE 57.—*Loxostege oxalis*, new species: 57, ventral view of female genitalia; 57a, detail of signum.

across end of cell a narrow, short, ochraceous-tawny line; termen narrowly edged with brown; cilia brownish. Hindwing ocherous white with a few small ochraceous-tawny spots on termen; cilia ocherous white. Legs ochraceous buff with slight tawny suffusion. Abdomen light ochraceous buff.

Female genitalia (slide 10426): Ostium broad, slitlike. Posterior third of ductus bursae sclerotized, remainder membranous, coiled.

Inception of ductus seminalis well before ostium. Signum a large, diamond-shaped, dentate plate.

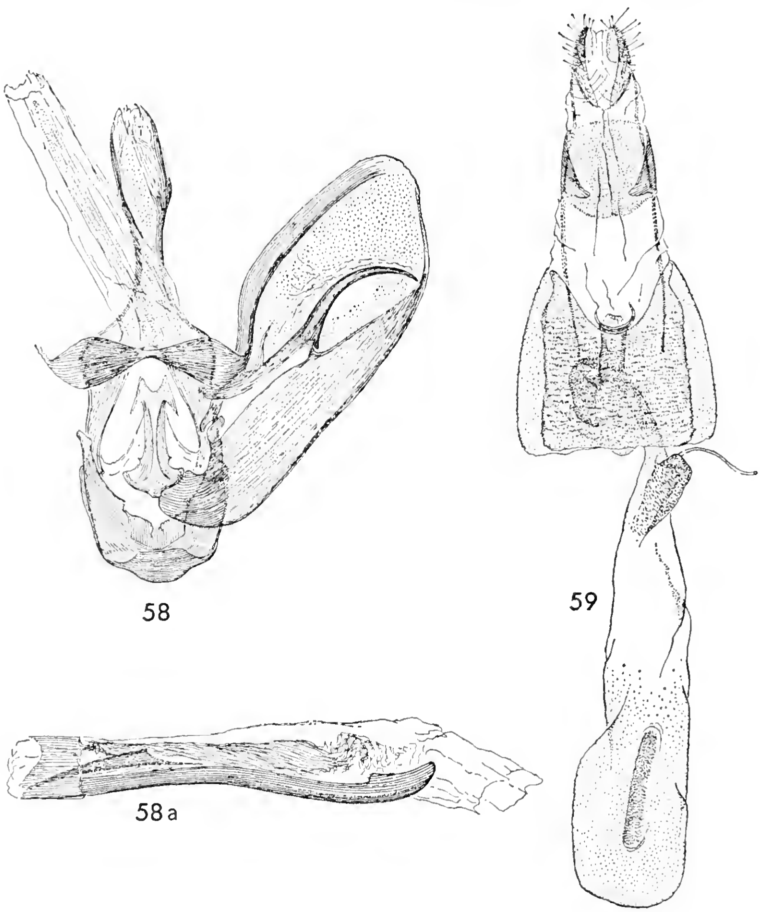
Type: Masatierra: Bahía Cumberland (Mar. 4, 1951). Described from the unique type female. There is no described species with which *oxalis* can be properly compared because the fauna of the area is too imperfectly known.

Genus *Nomophila* Hübner

Nomophila noctuella (Denis and Schiffermüller)

Figures 58–59

Phalaena Tinea noctuella Denis and Schiffermüller, 1775, Ankündung eines systematischen Werkes von den Schmetterlingen der Wienergegend, p. 136.



Figures 58–59.—*Nomophila noctuella* (Denis and Schiffermüller): 58, ventral view of male genitalia with left harpe and aedeagus removed; 58a, aedeagus; 59, ventral view of female genitalia.

Distribution: Masatierra: Bahía Cumberland ♂, 17 ♀♀ (December to March dates); Plazoleta del Yunque ♂, 2 ♀♀ (Jan. 2, 1952); Masafuera: Quebrada de la Calavera ♂, 2 ♀♀ (Jan. 15, 1952); Quebrada de las Casas, 5 ♀♀ (Jan. 16, 1952, Feb. 20, 1955).

This is an immigrant species which is nearly cosmopolitan in distribution. Wherever it is found, it is generally common in grassy areas.

Family Phycitidae

Genus *Elasmopalpus* Blanchard

Elasmopalpus angustellus Blanchard

Figures 60–61

Elasmopalpus angustellus Blanchard, 1852, *in* Gay, Historia física y politica de Chile. Zoologia, vol. 7, p. 105, Lepidoptera, pl. 7, fig. 14.

Elasmopalpus lignosellus Heinrich, 1956 (in part) *not* Zeller, U.S. Nat. Mus. Bull. 207, p. 173, figs. 33, 417, 906.

Type: Muséum National d'Histoire Naturelle, Paris.

Type locality: Concepción, Chile.

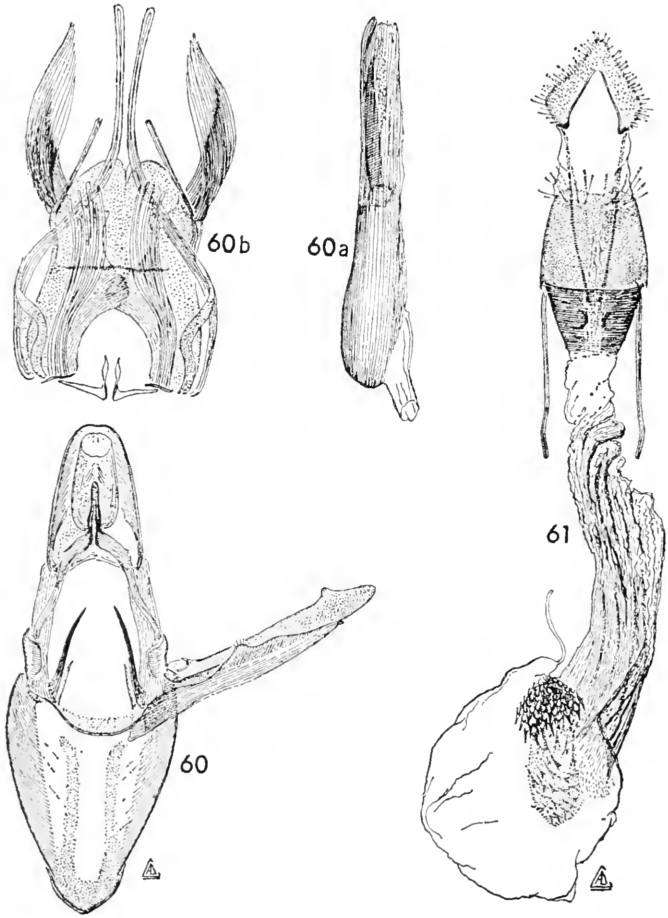
Distribution: Masafuera: Quebrada de las Casas, 3♂♂, ♀ (Jan. 16, 1952).

My thanks are due Mr. P. Viette, Muséum National d'Histoire Naturelle, Paris, who has examined Gay's type in that Institution, and compared the genitalia with my drawing. He writes as follows:

"I have examined the ♂ type specimen of *Elasmopalpus angustellus* Blanchard, from Chile. Your drawings correspond exactly with the genitalia of the type specimen in Paris Museum.—Slide P. Viette N:3544."

Although *angustellus* has been considered a synonym of *lignosellus* by various authors, there are abundant points of distinction. In the male genitalia there is a strong projection from the costa, slightly before cucullus, which is absent in *lignosellus*. The lateral arms of the anellus of *angustellus* are slender and only slightly curved, not strongly sclerotized, curved, pointed horns as in *lignosellus*. The single cornutus is thick, strongly sclerotized and nearly half the length of the aedeagus in *angustellus* but appreciably shorter and more slender in *lignosellus*. The ductus bursae of the female is broad and strongly sclerotized for over three-quarters of its length in *angustellus* and the spines of the two opposing sclerotized signa are stouter than in *lignosellus*.

For the above reasons I am removing *angustellue* from the synonymy of *lignosellus*. The specific name *E. angustellus* must be confined to the Chilean examples since all other specimens examined from



FIGURES 60–61.—*Elasmopalpus angustellus* Blanchard: 60, ventral view of male genitalia with left harpe and aedeagus removed; 60a, aedeagus; 60b, compound tufts of eighth abdominal segment; 61, ventral view of female genitalia.

Brazil, Argentina, Mexico, and North America are correctly assigned to *lignosellus*.

Family Pterophoridae

Genus *Stenoptilia* Hübner

Stenoptilia partiseca Meyrick

FIGURES 62–63

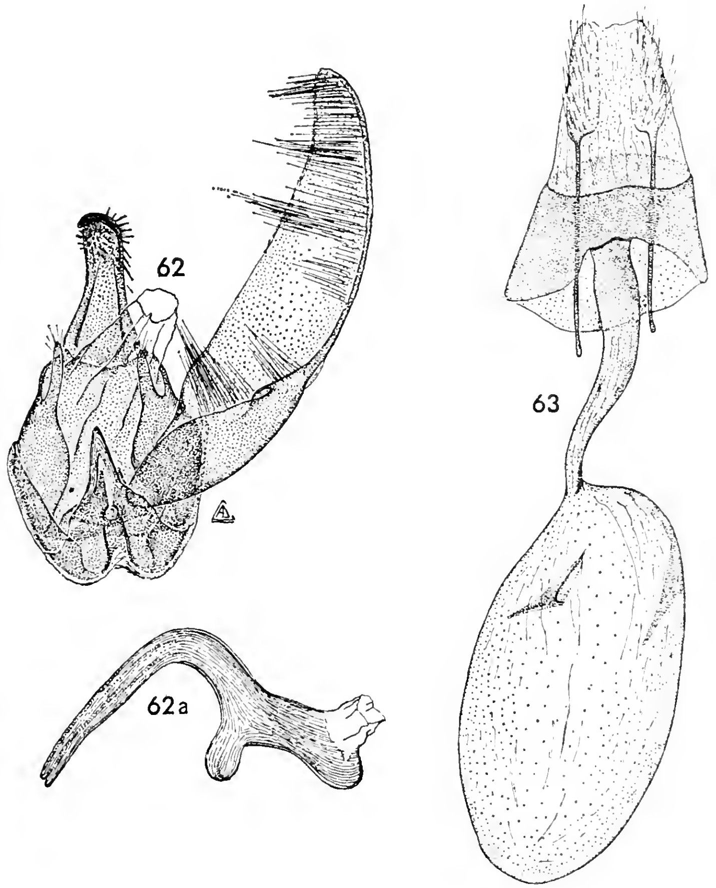
Stenoptilia partiseca Meyrick, 1931, Anales del museo nacional de historia natural, Buenos Aires, vol. 36, p. 380.

Type: British Museum (Natural History).

Type locality: Argentina, Mendoza Province, Mendoza.

Distribution: Masafuera: Quebrada de las Casas, ♂ (Jan. 25, 1952); ♀ (Jan. 22, 1955).

There is some doubt about the identity of the Juan Fernandez specimens despite the fact that the female genitalia compare quite favorably with those of the type. Mr. John D. Bradley, of the British Museum, kindly compared the Juan Fernandez specimens



Figures 62–63.—*Stenoptilia partiseca* Meyrick: 62, ventral view of male genitalia with left harpe and aedeagus removed; 62a, aedeagus; 63, ventral view of female genitalia.

with Meyrick's type and his remarks are as follows: "We have only the type, a female from Argentina. The coloration of the type is very much whiter than in your specimens, also there seems to be a very slight difference in the ostium. I hazard, as best one can from looking at a couple of females only, that these differences are not

specific, and I think it will be reasonable to put your specimens down as *partiseca*."

In choosing to accept this name, I assume complete responsibility if in error. Variability in certain plume moths is not uncommon, and the slight differences in the ostia of the two specimens examined are probably not important. When more material is gathered from both the mainland and the islands, the matter can be settled.

Genus *Platyptilia* Hübner

Platyptilia epidelta Meyrick

Figures 64–65

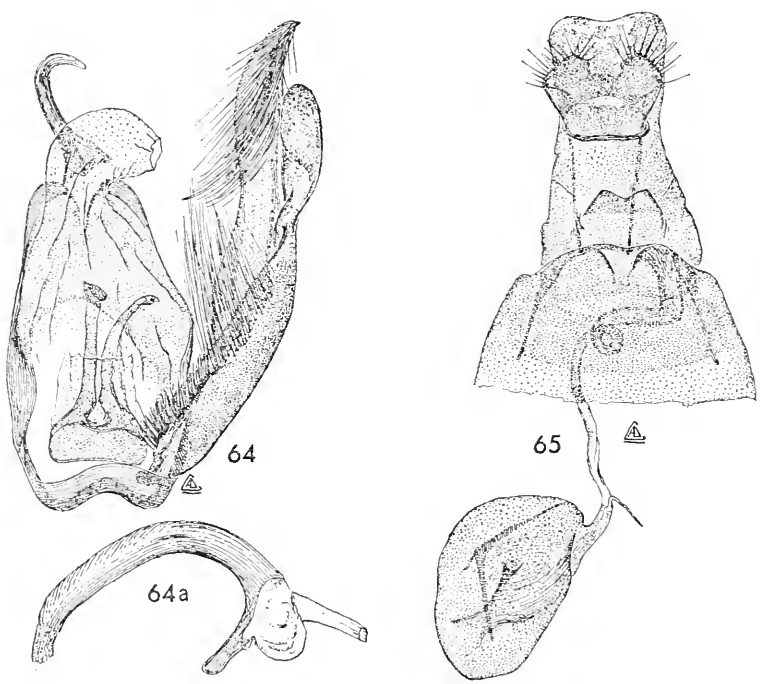
Platyptilia epidelta Meyrick, 1907, Trans. Ent. Soc. London, 1907, p. 486.

Type: British Museum (Natural History).

Type locality: Argentina: Paraná.

Distribution: Masatierra: Bahía Cumberland, 9 ♀♀ (Feb. 10–Mar. 20, 1951; Dec. 23–27, 1954; Mar. 18, 1955; Feb. 8, 1952).

My thanks are due Mr. John D. Bradley of the British Museum for examining specimens and comparing them with Meyrick's type. Mr. Bradley writes (*in litt.*) "There are slight differences in the valva



Figures 64–65.—*Platyptilia epidelta* Meyrick: 64, ventral view of male genitalia with left harpe and aedeagus removed; 64a, aedeagus; 65, ventral view of female genitalia.

of the male between your specimen and one of Meyrick's syntypes, but I attribute this to variation within the species. This species may be a synonym of *sematodactyla* Berg. . . . There is no authentic material in the B. M. for comparison but B. Fletcher had determined several specimens (without abdomens) from Argentina which appear superficially identical with your specimens."

Apparently *epidelta* is widespread, and perhaps carried in commerce, but only extensive collecting will determine the limits of distribution.

Family Tortricidae

Genus *Proeulia* Clarke

Proeulia Clarke, 1962, Proc. Biol. Soc. Washington, vol. 75, p. 293.

The species of *Proeulia* are separated by the following key:

Alar expanse 24–28 mm.; vesica with several long and one short, straight cornuti; signum with one small conical thorn. . . . . **robinsoni** Aurivillius

Alar expanse 15–20 mm.; vesica armed with two or more long, slightly curved cornuti and one short, strongly curved cornutus; signum with long, projecting spine. . . . . **griseiceps** Aurivillius

Proeulia robinsoni (Aurivillius)

Figures 66–69

Eulia robinsoni Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 266, pl. 11, fig. 17.

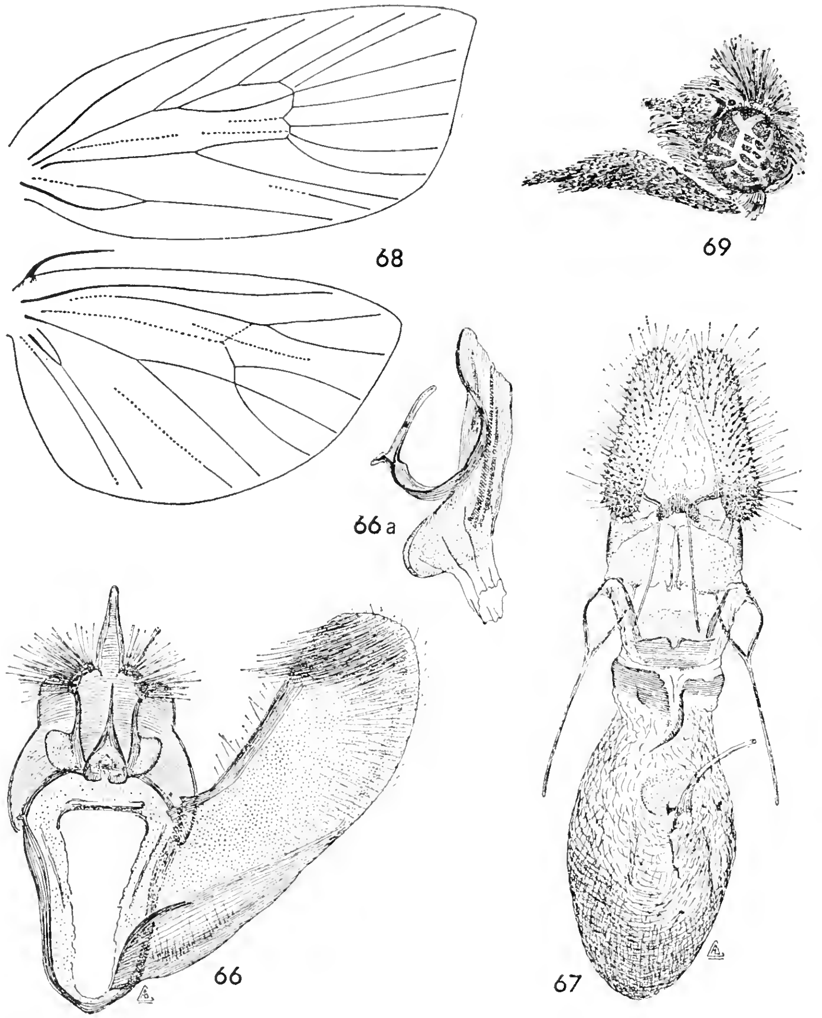
Proeulia robinsoni (Aurivillius), Clarke, 1962, Proc. Biol. Soc. Washington, vol. 75, p. 294.

Type: Naturhistoriska Riksmuseum, Stockholm.

Type locality: "Masatierra."

Distribution: Masatierra: Bahía Cumberland 3 ♀♀ (Feb. 15, 1951); Plazoleta del Yunque 2 ♂♂, 3 ♀♀ (Jan. 2, 1952); 2 ♂♂, 6 ♀♀ (Dec. 28, 1954).

This is the largest of the tortricids represented in the collections from the Juan Fernandez Islands and because of its large size is easily distinguished from the other species. It resembles Butler's *Dichelia exusta* but Mr. Bradley of the British Museum, who has compared a specimen of *robinsoni* with Butler's type, states "Somewhat similar to *exusta* Butler superficially, but in my opinion definitely not that species and I am unable to identify it from the B. M. collection." The type of Butler's species lacks the abdomen. The male and female genitalia of *robinsoni* are figured from slides 10179 and 10180 respectively. The wing is figured from the male 10179. This species appears to be confined to Masatierra.



FIGURES 66–69.—*Proeulia robinsoni* (Aurivillius): 66, ventral view of male genitalia with left harpe, anellus and aedeagus removed; 66a, lateral aspect of aedeagus and anellus; 67, ventral view of female genitalia; 68, venation of right wings; 69, lateral aspect of head to show palpus.

Proeulia griseiceps (Aurivillius)

FIGURES 70–71

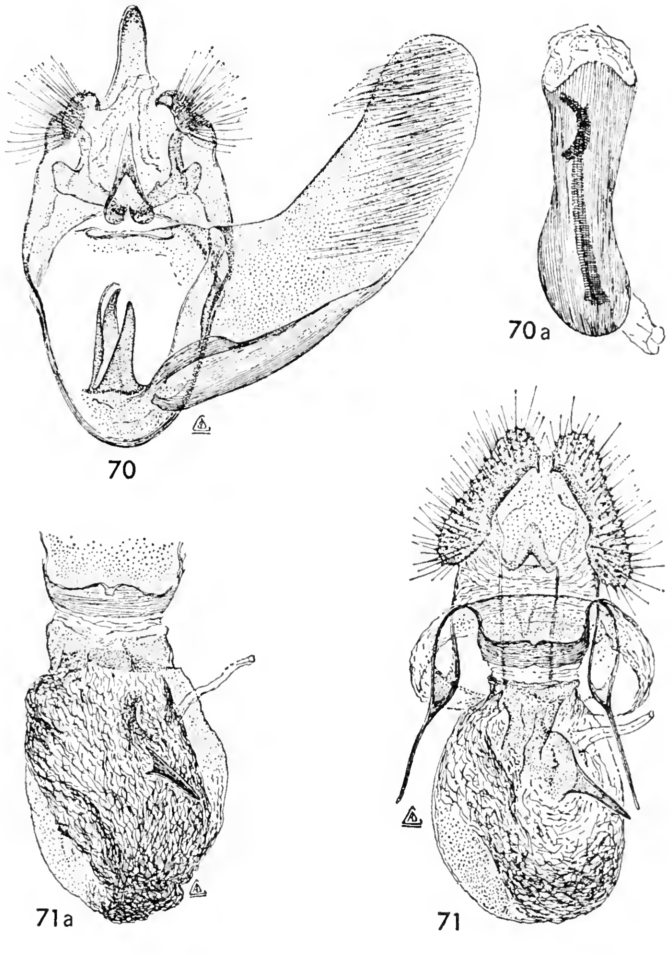
Eulia griseiceps Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 267, pl. 11, fig. 18.

Proeulia griseiceps (Aurivillius), Clarke, 1962, Proc. Biol. Soc. Washington, vol. 75, p. 294.

Eulia striolana Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 267, pl. 11, fig. 19 (new synonymy).

Types: Naturhistoriska Riksmuseum, Stockholm.

Distribution: Masatierra: Alto Francés, 450 m., ♂ (Jan. 16, 1955); El Camote, 600 m., ♂ (Jan. 9, 1955); Plazoleta del Yunque, 200 m., 9 ♂♂, 3 ♀♀ (March–December 1951–1955); Quebrada la Laura, ♂, ♀ (Mar. 1, 1951); Salsipuedes, ♀ (Mar. 5, 1955).



Figures 70–71.—*Proeulia griseiceps* (Aurivillius): 70, ventral view of male genitalia with left harpe and aedeagus removed; 70a, aedeagus; 71, ventral view of female genitalia; 71a, bursa copulatrix to show variation in signum.

It is not surprising that Aurivillius described *griseiceps* as two species, and undoubtedly his other two segregates, no. 26 and no. 27, belong here. An examination of the genitalia of the two type females,

however, removes any doubt about their identity. Had Aurivillius made dissections, he would have seen that he had examples of one extremely variable species. As a matter of fact, there are almost as many color forms as there are specimens but the genitalia are remarkably constant.

Male genitalia figured from a specimen from Plazoleta del Yunque (slide 10181). Female genitalia figured from specimens from Quebrada la Laura (slides 10182, 10367).

Nesochoris, new genus

Type-species: *Nesochoris holographa*, new species.

Antenna ciliate in male (female unknown). Labial palpus porrect, about one-fourth longer than head; third segment less than one-third the length of second, slightly drooping. Head somewhat roughened. Forewing smooth, termen oblique, slightly concave between veins 4 and 7; 12 veins, all veins separate; 1c strongly preserved at margin; 2 from outer two-thirds of cell; 3, 4, and 5 separate and about equidistant at bases; 6, 7, 8 separate and about equidistant at bases, 7 to termen well below apex; 11 from slightly before middle of cell; upper internal vein from between veins 10 and 11. Hindwing with 8 veins; 2 from well before end of cell; 3 and 4 connate; 5 approximate to 4; 6 and 7 short stalked.

Male genitalia: Harpe simple, short, broadly attached, gnathos and uncus present; socii obsolete; transtilla indicated by membrane only; anellus a simple plate; vesica armed with weak, slender cornuti.

Nesochoris and *Proeulia* are very similar in outward appearance but the male genitalia separate them easily. *Proeulia* exhibits strongly developed socii and transtilla and strongly fused gnathos. In *Nesochoris*, however, the socii are indicated by only a few weak setae, the transtilla is practically nonexistent and the lateral and central elements of the gnathos are separate.

The species of *Nesochoris* are separated by the following key:

Alar expanse more than 20 mm., forewing covered with small spots and short transverse dashes of ferruginous scales . . . . **holographa**, new species
Alar expanse less than 15 mm., forewing covered with scattered brick-red scales and costa with eight small fuscous spots . . . . . **brachystigma**, new species

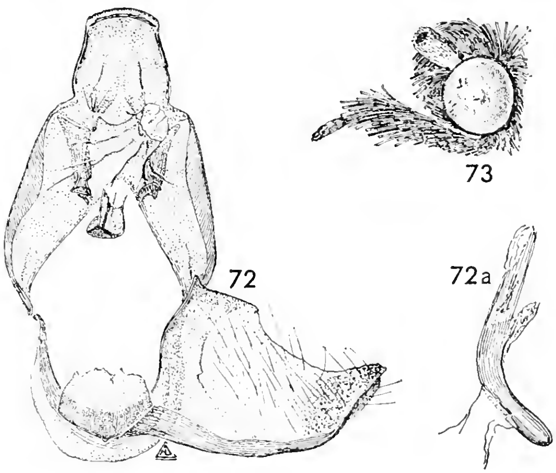
Nesochoris holographa, new species

FIGURES 72–73

Alar expanse 22 mm.

Labial palpus pale clay color outwardly mixed with ferruginous; third segment fuscous tipped. Antenna clay color; scape ferruginous dorsally; remainder of segments ferruginous apically; antennal cilia-

tions slightly more than one. Head clay color suffused with grayish; face with a transverse band of ferruginous and a spot of similar color between antennae anteriorly. Palpus and head with slight purplish iridescence. Thorax and ground color of forewing grayish, the former mixed with ferruginous scales, the entire surface of the latter covered with short transverse dashes and small spots of the same color; on costal two-fifths, two narrowly separated, gray oblique lines delimiting a narrow, obscure, irregular, outwardly oblique transverse band, the termination of which is indicated by a ferruginous spot on dorsum well before tornus; on dorsum, at basal fourth, an obscure, moderately large, ferruginous spot; cilia clay color with a dark basal line of mixed gray and ferruginous scales; forewing, especially dark markings with



FIGURES 72–73.—*Nesochoris holographa*, new species: 72, ventral view of male genitalia with left harpe and aedeagus removed; 72a, lateral aspect of aedeagus; 73, lateral aspect of head to show palpus.

purplish iridescence and forewing and hindwing with considerable reddish-brown mottling on undersides. Hindwing light reddish brown, paler basally; cilia ferruginous apically, gradually becoming ocherous white at anal angle and all with a dark gray subbasal line. Legs ocherous white suffused and shaded with fuscous and ferruginous; foretarsi fuscous with pale annulations. Abdomen ocherous white; below irrorate with fuscous and ferruginous and with slight purplish iridescence.

Male genitalia (slide 10368): In addition to the larger size of the genitalia of *holographa*, they differ from *brachystigma* by the sharp angle formed between the uncus and posterior margin of the tegumen. In *brachystigma* the lateral edges of the uncus are confluent with the posterior edge of the tegumen.

Type: Masatierra: Plazoleta del Yunque, 200 m. (Feb. 9, 1952). Described from the unique male type.

***Nesochoris brachystigma*, new species**

FIGURE 74

Alar expanse 14 mm.

Labial palpus white; second segment brick red outwardly, suffused fuscous apically; third segment almost wholly fuscous. Antenna, scape buff with fuscous above; remainder fuscous with paler annulations; antennal ciliations slightly over one. Head olive buff suffused with fuscous anteriorly and with some brick-red scales laterally. Thorax gray mixed with dull ocherous and with some brick-red scales posteriorly. Forewing ground color gray; from basal fourth of costa an outwardly oblique transverse fascia extends to middle of dorsum,

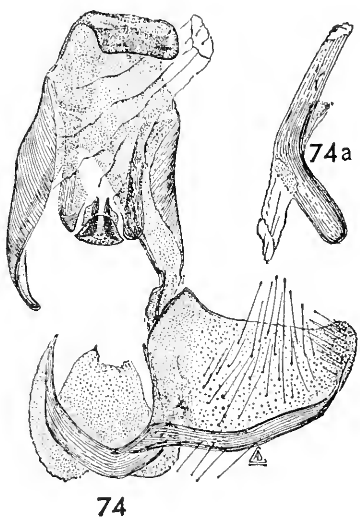


FIGURE 74.—*Nesochoris brachystigma*, new species: 74, ventral view of male genitalia with left harpe and aedeagus removed; 74a, lateral aspect of aedeagus.

the fascia nearly twice as wide at dorsum as on costa and bordered by brick-red transverse lines; the light fascia is suffused gray; costa with eight small fuscous spots, and in apical fourth of wing some indistinct mottling of the same color; entire surface of wing with scattered brick-red scales; cilia olive buff mixed with brick-red ocherous. Hindwing fuscous, somewhat paler basally; cilia paler with a fuscous subbasal line. Legs olive buff; foreleg heavily overlaid with brick red, tarsi fuscous with pale annulations. Abdomen grayish fuscous, somewhat paler ventroanteriorly; anal tuft pale, grayish.

Male genitalia (slide 10369): Aside from size, there is little to distinguish the genitalia of *brachystigma* from those of *holographa*.

Type: Masatierra: El Rabanal, 350 m. (Feb. 27, 1951).

Described from the unique type male.

Family Olethreutidae

Parasuleima, new genus

Type-species: *Crocidosema* (?) *insulana* Aurivillius.

Antenna finely and shortly pubescent. Labial palpus porrect, about twice as long as head; third segment two-thirds the length of second and obscured by long, projecting scales of second segment. Head rough. Forewing smooth, narrow; termen concave between veins 3 and 6; 12 veins; 2 from slightly beyond middle of cell; 3, 4, and 5 approximate at base; 7 and 8 separate; 11 from well before middle of cell; upper internal vein from between 10 and 11. Hindwing with 7 veins; 2 from well before angle; 3 and 4 united; 5 approximate at base; 6 and 7 closely approximate for short distance beyond base.

Female genitalia with signa.

This genus is similar to the North American *Suleima* Heinrich but differs from it by having 12 veins in the forewing, and a longer, more slender palpus. The Indian genus *Agriophanes* Meyrick possesses the same venation as *Parasuleima* but is a broadwinged type without a markedly concave termen in the forewing.

Two specimens of *insulana* have very short branches of veins 3 and 4 of the hindwing, but only on one side in each specimen.

I have not seen a male but according to Aurivillius' description, he could find neither costal fold nor hair pencil.

Parasuleima insulana (Aurivillius), new combination

FIGURES 75–77

Crocidosema (?) *insulana* Aurivillius, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Islands, vol. 3, pt. 2, p. 267, pl. 11, fig. 20.

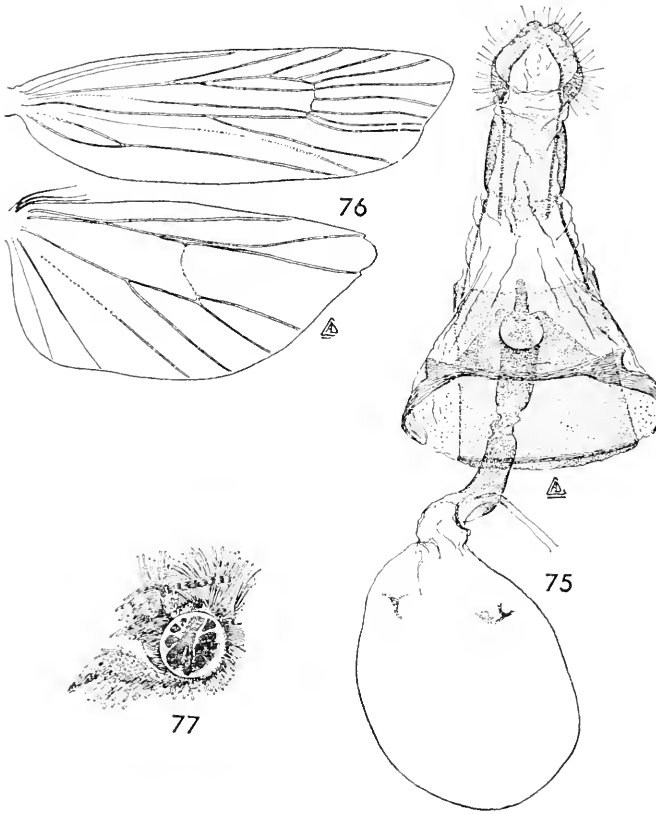
Type: Naturhistoriska Riksmuseum, Stockholm.

Type locality: "Masatierra."

Distribution: Masatierra: Bahía Cumberland, 10 ♀♀ (Mar. 8, 1951; Jan. 1 to Feb. 4, 1955).

Female genitalia figured from slide 10186.

It appears this species is confined to the island of Masatierra, none having been taken elsewhere on the several expeditions.



FIGURES 75–77.—*Parasuleima insulana* (Aurivillius): 75, ventral view of female genitalia; 76, venation of right wings; 77, lateral aspect of head to show palpus.

Family Oecophoridae

Genus *Martyrhilda* Clarke

Martyrhilda relegata (Meyrick), new combination

FIGURES 78–79

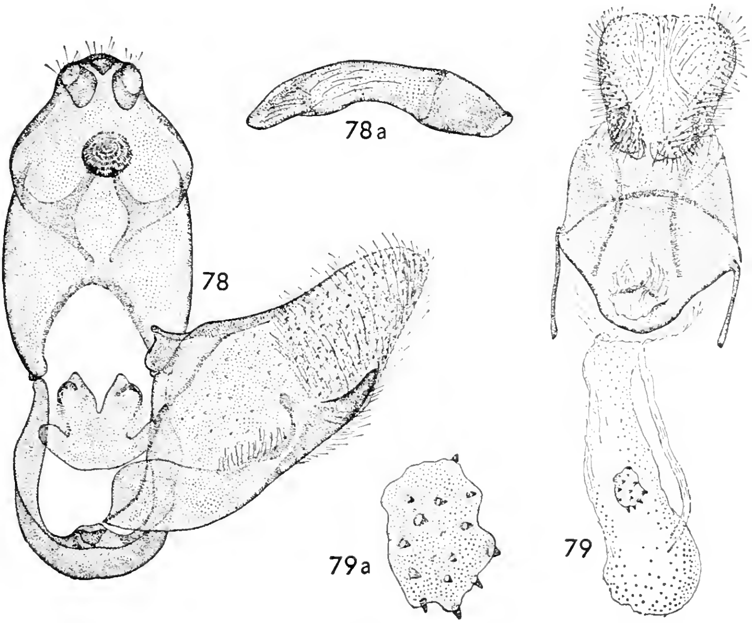
Depressaria relegata Meyrick, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 268.

Alar expanse 18–21 mm.

Male genitalia (slide 10587): Harpe broad basally; cucullus rather narrow, bluntly pointed; clasper with transverse arm reduced, extending less than half the width of harpe; longitudinal arm more than twice the length of transverse arm, compressed distally. Uncus small, sharply pointed. Socii naked flaps. Gnathos a small, rounded, spined knob. Anellus a strongly sclerotized plate with basal-lateral

lobes and deeply cleft posterior edge. Vinculum simple, rounded. Aedeagus, stout, slightly bent, pointed, unarmed.

Female genitalia (slide 10586): Typical of the genus. Genital plate broad, with anterior edge strongly convex. Ostium roughly



FIGURES 78–79.—*Martyrhilda relegata* (Meyrick): 78, ventral view of male genitalia with left harpe and aedeagus removed; 78a, aedeagus; 79, ventral view of female genitalia; 79a, detail of signum.

diamond shaped. Inception of ductus seminalis slightly before ostium. Ductus bursae not well distinguished from bursa copulatrix. Signum a subrectangular, dentate plate.

Type: Naturhistoriska Riksmuseum, Stockholm.

Type locality: "Masatierra."

Although described in *Depressaria*, this species must be referred to *Martyrhilda* on the stalked veins 2 and 3 of forewing and structure of the genitalia. There are no specimens of *relegata* in the material at hand, but it was described from 11 specimens indicating that it must be relatively common.

Genus *Endrosis* Hübner

Endrosis sarcitrella (Linnaeus)

Phalaena tinea sarcitrella Linnaeus, 1758, Systema naturae, ed. 10, p. 536.

Distribution: Masafuera: Quebrada de las Casas, 2 ♀♀ (Jan. 17–24, 1952); 2 ♀♀ (Feb. 1, 20, 1955); Masatierra: Bahía Cumberland

5 ♂♂, 5 ♀♀ (Feb. 15–Mar. 10, 1951; Feb. 3, 1952; Mar. 3, 13, 1955); Plazoleta del Yunque, 200 m., ♂ (Feb. 20, 1951).

Previously recorded by Meyrick from Masafuera from a single specimen. It may be expected around almost any human habitation.

This species has previously appeared in American lists as *Endrosis lactella* (Denis and Schiffermüller), and was recorded by Meyrick as such. The latter is a synonym, and this present combination is in accordance with contemporary usage.

For an extended bibliography on this species, up to 1940, see Clarke, J. F. G., 1941, Proc. U.S. Nat. Mus., vol. 90, pp. 264–266.

Family Gelechiidae

Genus *Gnorimoschema* Busck

Key to the Species of *Gnorimoschema*

1. Third segment of labial palpus with two distinct dark annuli 2
   Third segment of labial palpus otherwise 3
2. Forewing with conspicuous pale area between two dark blotches in center of wing; male with strong black sex-scaling on underside of fore- and hindwings and upper side of latter . . . . **melanolepis**, new species
   Forewing without conspicuous pale area; markings consisting of fine streaks, three fuscous discal spots and scattered whitish scales; male without sex-scaling . . . . **absoluta** (Meyrick)
3. Third segment of labial palpus with black spot at base anteriorly; forewing clay colored shaded grayish toward costa . . . . **hemilitha**, new species
   Third segment of labial palpus without black spot at base anteriorly; forewing grayish toward costa, darker dorsally but never clay colored. **operculella** (Zeller)

Gnorimoschema absoluta (Meyrick), new combination

Figure 80

Phthorimaea absoluta Meyrick, 1917, Trans. Ent. Soc. London, 1917, p. 44.

Food plants: *Solanum tuberosum* L. (potato); *Lycopersicon esculentum* (L.) Mill. (tomato).

Distribution: Masatierra: Bahía Cumberland, 8 ♀♀ (Feb. 14–Mar. 20, 1951; Mar. 12–18, 1955).

Meyrick described this species from a unique male from Huancayo, Peru. In the U.S. National Museum there is a series, bred from potato and tomato, from Chile, Peru and Venezuela. As a pest of potato and tomato we can expect to find *absoluta* rather generally distributed because it is undoubtedly carried in commerce.

The female genitalia have not previously been figured.

FIGURE 80.—*Gnorimoschema absoluta* (Meyrick): ventral view of female genitalia.

***Gnorimoschema hemilitha*, new species**

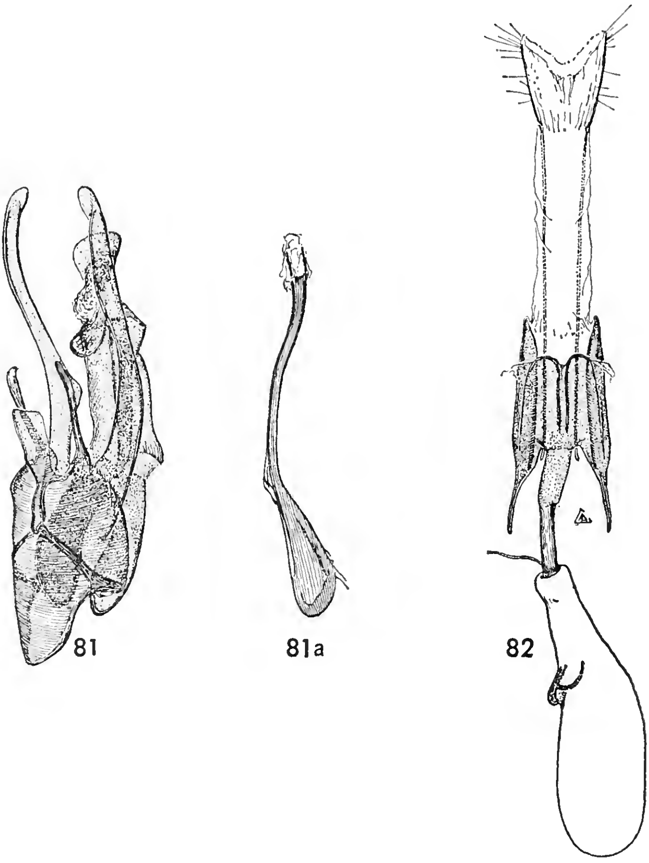
FIGURES 81–82

Alar expanse 9–11 mm.

Labial palpus sordid white; second segment with white-tipped, dark gray scales in brush and on outer side; third segment with a black spot at base anteriorly and a broad black subterminal annulus. Antenna dark gray with a whitish spot on each segment beneath. Head light grayish olive except dark gray, white-tipped scales around eye. Thorax and ground color of forewing clay color; thorax with some grayish suffusion in some specimens; costal half suffused grayish, irrorate with many white-tipped, dark gray scales; two clouded areas in center of wing; discal stigmata three, dark gray, one at one-third in cell, one in fold slightly beyond first and one at end of cell; cilia pale grayish, mixed with white-tipped, dark gray scales. Hindwing light grayish fuscous; cilia paler. Fore- and midlegs gray irrorate with sordid white, tarsi sordid white annulated; hindleg gray overlaid with sordid white on inner side; tarsi annulated with sordid white beneath.

Male genitalia (slide 10403): Dorsal element of harpe as long as tegumen and uncus combined, abruptly broadened basally, scarcely

dilated distally; ventral element less than one-third the length of dorsal element, curved, compressed and dilated distally, terminating in a short, recurved sharp point. Uncus narrowed posterior to middle, flared distally. Uncus spoon shaped. Vinculum narrowly rounded anteriorly, and with moderately long projection posteriorly. Aedeagus about as long as uncus and tegumen combined, curved, slender, dilated proximally.



FIGURES 81–82.—*Gnorimoschema hemilitha*, new species: 81, oblique view of male genitalia with aedeagus removed; 81a, aedeagus; 82, ventral view of female genitalia.

Female genitalia (slide 10404): Ductus bursae about one-half the length of bursa copulatrix, sharply constricted at bursa; inception of ductus seminalis at junction of ductus bursae and bursa copulatrix. Signum a strong, but rather slender hook. Ostium slitlike.

Type: Masatierra: Bahía Cumberland, ♂ (Feb. 17, 1951).

Described from the type male, three male and six female paratypes, all from Bahía Cumberland (January to March dates, 1951–1955).

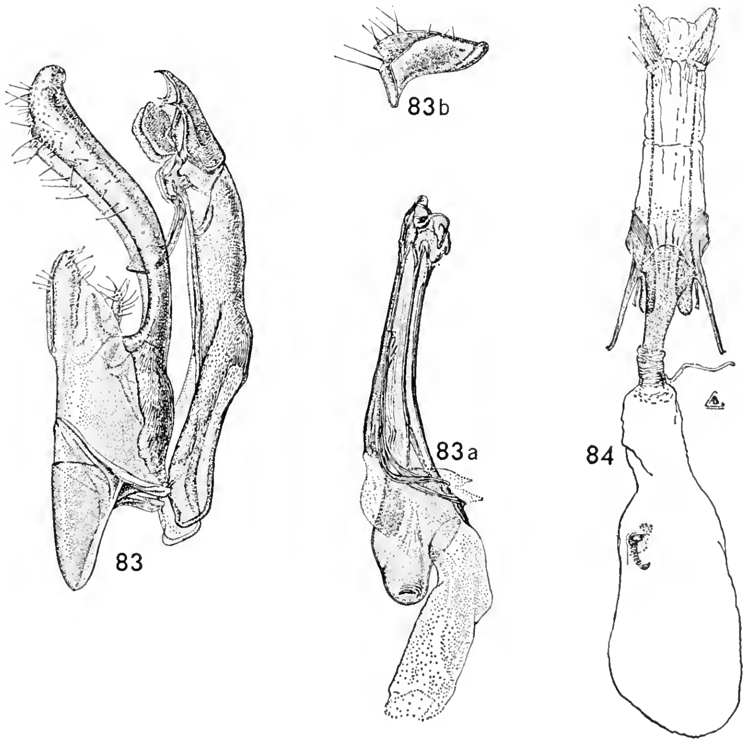
In general appearance *hemilitha* is similar to *altisona* Meyrick, but the head, thorax, and ground color of forewing are lighter. In *altisona* the harpe does not exceed the uncus, as in *hemilitha*, and the aedeagus is short, stout, and greatly dilated in basal half. The female of *altisona* is not known, so no comparison of the genitalia can be made.

Gnorimoschema melanolepis, new species

FIGURES 83–84

Alar expanse 11–13 mm.

Labial palpus cinereous, irrorate with dark gray; second segment grayish fuscous at base; third segment with broad, black basal and supramedial annuli. Antenna cinereous with blackish-fuscous annulations; basal segment blackish fuscous. Head cinereous, the scales narrowly whitish tipped. Thorax fuscous with a few paler scales mixed; tegula cinereous with a few scattered fuscous scales. Forewing cinereous, irrorate and suffused with grayish fuscous; at base of



FIGURES 83–84.—*Gnorimoschema melanolepis*, new species: 83, lateral aspect of male genitalia with aedeagus removed; 83a, lateral aspect of aedeagus; 83b, ventral view of apical portion of dorsal arm of harpe; 84, ventral view of female genitalia.

wing, in fold, a small fuscous spot and slightly beyond, costad, a similar mark; at basal third, in cell, a conspicuous fuscous blotch extending obliquely and outwardly to slightly beyond fold; a similarly colored, subquadrate blotch extends from middle of wing, in cell, to fold; area between the two large dark blotches, and beyond the outer one, conspicuously paler, less irrorate with fuscous than rest of wing and with scattered ocherous scales; cilia pale grayish fuscous. Hindwing pearly gray in male, gray in female; cilia pale grayish fuscous. In the male the undersides of both fore- and hindwings are clothed with heavy, black sex-scaling; upper side of male hindwing with black sex-scaling along costa and inner margin and also with conspicuous whitish-ocherous hair pencil from upper surface of costa. Foreleg cinereous, femur and tibia shaded with fuscous on outer side; tarsi fuscous annulated, mid- and hindlegs cinereous, irrorate and shaded with fuscous. Abdomen grayish fuscous above, sordid white beneath; anal segment ocherous white.

Male genitalia (slide 10751): Dorsal element of harpe about as long as tegumen, curved ventrad, gradually thickening to near distal end, then sharply curved inwardly, terminating in a sharp point; ventral element small, papillate. Gnathos spoon shaped, broadly expanded distally. Uncus short, pointed posteriorly. Vinculum produced posteriorly with edge deeply incised, anterior margin rounded. Aedeagus about as long as tegumen, slightly curved, stout, distal end slightly dilated, proximally bulbous.

Female genitalia (slides 10410, 10752): Ostium broad. Ductus bursae less than half the length of bursa copulatrix, narrowly funnel shaped, sclerotized except for short membranous section before middle; ductus seminalis from junction of ductus bursae and bursa copulatrix; signum a strong, slightly curved, thornlike process arising from a slender, elongate, sclerotized base.

Type: Masafuera: Quebrada de las Casas (Jan. 22, 1955).

Described from the type male and one female paratype, both with identical data.

The conspicuous, black sex-scaling, plus the hair pencil from the hindwing at once distinguish the male from other species. The female, however, is distinguished chiefly by the pale area between the two large dark blotches of the forewing.

Gnorimoschema operculella (Zeller)

Gelechia (?Bryotropha) operculella Zeller, 1873, Verh. K. Zool-Bot. Gesell. Wien, vol. 23: p. 262, fig. 17.

Distribution: Masatierra: Bahía Cumberland, 3 ♀♀ (Mar. 4–12, 1955).

Another widely distributed pest, the notorious "potato tuberworm," may be expected wherever potatoes are shipped commercially.

Echinoglossa, new genus

Type-species: *Echinoglossa trinota*, new species.

Antenna simple in female, finely serrate in male, nearly as long as forewing, basal segment without pecten. Labial palpus upturned; second segment somewhat roughened beneath with brush expanded apically; third segment about as long as second, smooth, acute. Head smooth, ocellus small, posterior; tongue well developed, thickly scaled basally. Hind tibia slightly roughened above with long, slender scales. Forewing smooth, apex greatly produced, attenuated; 12 veins; 2 remote from 3; 4 and 5 stalked, about as far from 3 as 3 is from 2; 6 from upper angle of cell, connate with 9, to termen; 7 and 8 stalked out of 6; 9, 10, and 11 about equidistant. Hindwing with 8 veins; 2 distant from 3; 3 and 4 connate; 5 curved, well separated from 4; 6 and 7 parallel; crossvein between 7 and 8 present near base.

Male genitalia typically gelechiid. Dorsal and ventral elements of harpe present. Gnathos present. Aedeagus unarmed.

Female genitalia with well-developed signum.

In the large family Gelechiidae relatively few genera have veins 4 and 5 stalked in the forewing as in this new genus *Echinoglossa*. Of the genera with this character that I have examined, *Agathactis, Alsodryas, Dissoptila, Eristhenodes, Molopostola, Synactias,* and *Tholerostola* all are South American. The Indian *Ischnophenax* and African *Epenteris* approach the South American genera by having connate veins 4 and 5 but apparently the stalked condition of these veins is largely an American development.

Echinoglossa is perhaps most nearly related to *Dissoptila* but in the latter genus, vein 6 of forewing is separate from the stalked veins 7 and 8 and the apex is not produced as in the former. Also, in the hindwing, veins 4 and 5 are connate in *Dissoptila,* separate in *Echinoglossa.*

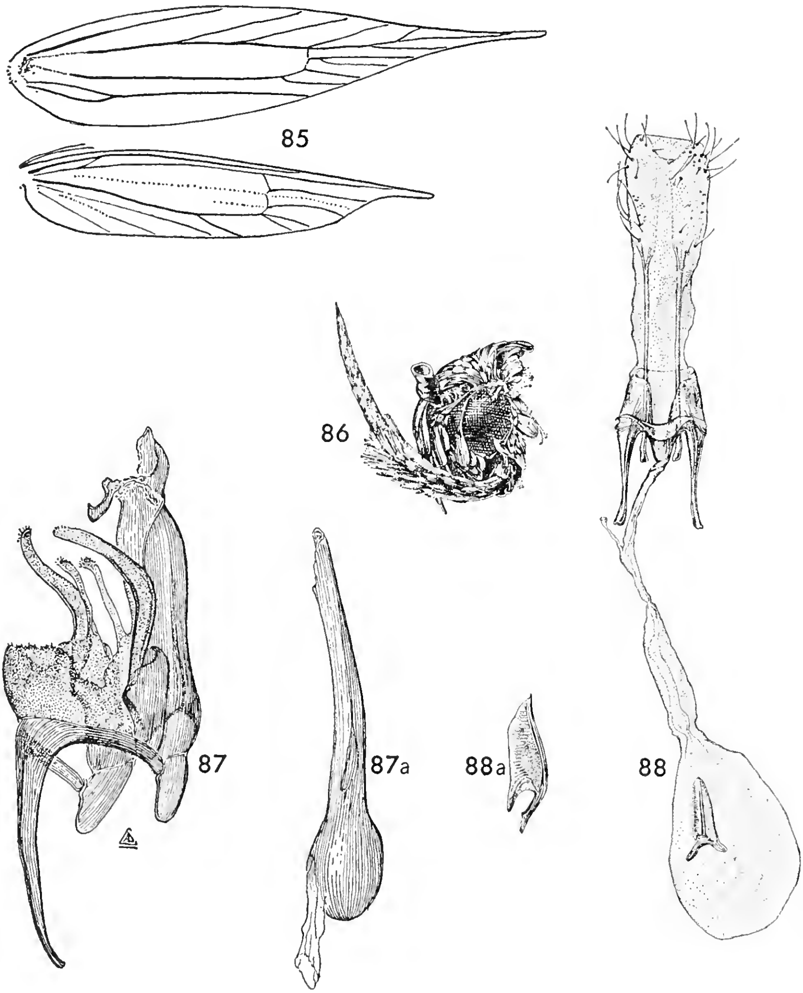
Echinoglossa trinota, new species

FIGURES 85–88

Alar expanse 9–10 mm.

Labial palpus sordid white; second segment shaded with dark gray in apical half; third segment with a dark gray, anterior, longitudinal line. Antenna dark gray with paler annulations. Head, thorax, and ground color of forewing cinereous; head and thorax with slight infuscation; base of costa narrowly fuscous; stigmata

three, fuscous, one in fold at two-fifths, one on costal edge of cell at one-third, and one at end of cell; on outer third of costa, around apex and along termen a series of ill-defined small fuscous spots; apical third of wing with scattered ocherous scales; cilia cinereous. Hindwing gray; cilia grayish fuscous. Legs cinereous shaded with fuscous. Abdomen dark gray above, cinereous beneath.



FIGURES 85–88.—*Echinoglossa trinota*, new species: 85, wing venation; 86, lateral aspect of head to show palpus; 87, oblique view of male genitalia with aedeagus removed; 87a, aedeagus; 88, ventral view of female genitalia; 88a, lateral aspect of signum to show longitudinal keellike ridge.

Male genitalia (slide 10448): Dorsal element of harpe about half as long as tegumen, curved; ventral element slender, digitate. Vin-

culum produced into a long point anteriorly, posterior edge roughened. Gnathos a small hook. Uncus comparatively weak, hood shaped. Aedeagus as long as tegumen and uncus combined, slightly curved, bulbous basally.

Female genitalia (slides 10444, 10756): Ostium moderately broad, slitlike. Ductus bursae sclerotized posteriorly. Signum a well-developed triangular plate with a high central longitudinal ridge.

Genus *Apothetoeca* Meyrick

Apothetoeca Meyrick, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2. p. 268.

Type-species: *Apothetoeca synaphrista* Meyrick, ibid., p. 269 [by monotypy].

Apothetoeca synaphrista Meyrick

Figures 89–90

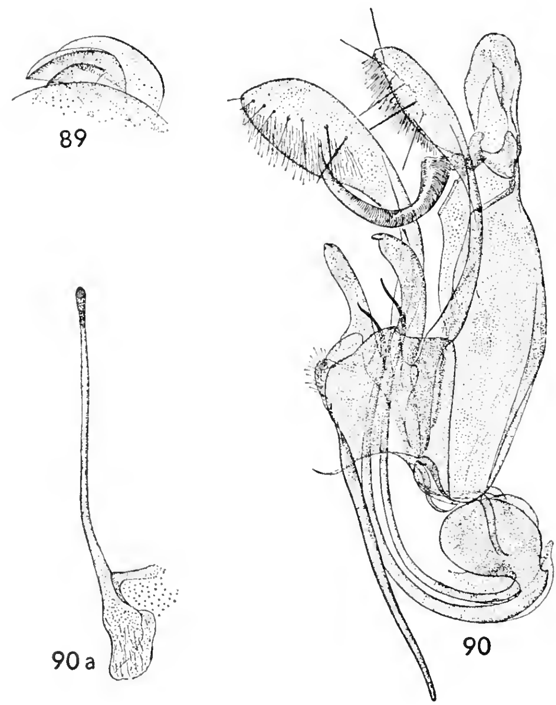
Apothetoeca synaphrista Meyrick, 1922, *in* Skottsberg, The natural history of Juan Fernandez and Easter Island, vol. 3, pt. 2, p. 269.

Male genitalia: Dorsal arm of harpe long, curved but not exceeding uncus; distal end strongly dilated and clothed with large, broad scales; ventral arm of harpe stout with a somewhat hooked point. Uncus rather narrow, thickened, bluntly pointed. Gnathos long, curved, beaklike. Vinculum narrowly produced anteriorly, as long as tegumen. Anellus arising as a paired bulbous process and produced into a pair of slender recurved branches. Aedeagus slender, nearly straight, greatly enlarged basally.

Type: Naturhistoriska Riksmuseum, Stockholm.

Type locality: "Masatierra."

There are no specimens of this species in the present collection, and it is known only from the type. In my key I have brought *Apothetoeca* out in the same couplet with *Pseudarla*, and the character used to separate it from *Pseudarla* is the connate condition of veins 3 and 4 of the hindwing. On the intersegmental membrane of *Apothetoeca*, between the 8th abdominal segment and the genitalia, there are numerous large, conspicuous, bulbous scales. These are readily deciduous and must be treated carefully to prevent their removal. From each side of the 8th segment there is a long hair pencil. All of these secondary characters, together with the peculiar scale thickening of the antenna mentioned by Meyrick, are undoubtedly confined to the male. The genitalia of the male are characteristically gelechiid and, in general form, are similar to *Gelechia*. The aedeagus of *Apothetoeca* is extremely slender and arises anterior to the tegumen between two long, curved arms of the anellus.



FIGURES 89–90.—*Apothetoeca synaphrista* Meyrick: 89, modified scales of dorsal arm of harpe; 90, oblique view of male genitalia with aedeagus removed; 90a, aedeagus.

Pseudarla, new genus

Type-species: *Pseudarla miranda*, new species.

Antenna nearly as long as forewing, thickened in male (female unknown); basal segment with pecten. Labial palpus recurved; second segment long, moderately slender, slightly roughened beneath; third segment nearly as long as second, slender, acute. Head smooth, ocellus small, posterior; tongue well developed. Hind tibia clothed with moderately long scales above. Forewing smooth, apex pointed, termen strongly oblique; 12 veins; 2 remote from 3; 3 from slightly before angle of cell; 3, 4, and 5 nearly equidistant at bases; 7 and 8 stalked, 7 to costa. Hindwing with 8 veins; 2 distant from 3; 3 from well before angle of cell; 6 and 7 long stalked.

Male genitalia with uncus clothed with long hairlike setae. Aedeagus unarmed. Gnathos well developed.

Pseudarla is similar to *Arla* Clarke and *Lita* Treitschke and all possess unusually long antennae. On the uncus in all three genera the posterior surface is densely clothed with long hairlike scales. *Pseudarla* can be distinguished from both *Arla* and *Lita* by the stalked veins

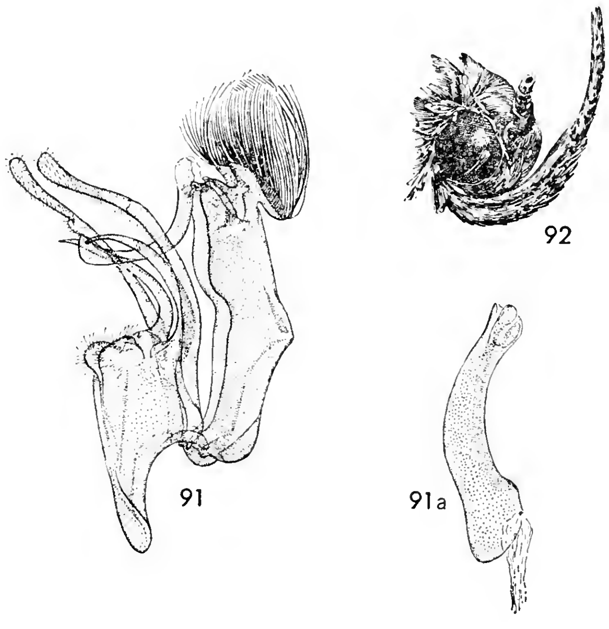
6 and 7 of the hindwing, and the presence of antennal pecten. Veins 6 and 7 of the hindwing are separate and nearly parallel in both *Lita* and *Arla*. *Pseudarla* can be further distinguished from *Arla* by the aedeagus which is unarmed in the former and armed in the latter. The uncus of *Pseudarla* is reduced posteriorly and extends anteriorly over the tegumen, but in *Lita* the uncus is narrowly hood shaped.

Pseudarla miranda, new species

FIGURES 91–92

Alar expanse 23 mm.

Labial palpus buff; second segment suffused with fuscous on outer side, third segment almost wholly overlaid with fuscous. Antenna brownish buff with narrow fuscous annulations. Head, thorax, and ground color of forewing avellaneous; face, head somewhat lustrous; costa lightly suffused with fuscous to outer two-thirds from which point an outwardly oblique, transverse, fuscous band extends to vein 6, thence inwardly to tornus; a blotch on dorsum at one-third and three discal spots, fuscous; inner and outer discal spots small, ill defined, central one larger and more distinct; in fold, beyond basal discal spot, a slender fuscous dash extends beneath central discal spot; costa, beyond transverse band, with three fuscous bars, these con-



FIGURES 91–92.—*Pseudarla miranda*, new species: 91, lateral aspect of male genitalia with aedeagus removed; 91a, aedeagus; 92, lateral view of head to show palpus.

fluent with apical fuscous shading; cilia avellaneous, speckled with fuscous. Hindwing brownish buff with some fuscous suffusion; cilia brownish buff with a darker subbasal line. Fore- and midlegs fuscous with buff annulations; hindleg buff suffused with fuscous. Abdomen pale buff with fuscous suffusion above and indistinct row of fuscous spots laterally beneath.

Male genitalia (slide 10591): Dorsal element of harpe twice as long as ventral element, slender, slightly dilated distally; ventral element slender, pointed. Gnathos a strong hook, straightened somewhat and compressed distally. Uncus produced anteriorly, densely clothed with hairlike setae. Vinculum somewhat produced anteriorly, rounded; posterior edge fleshy, clothed with fine setae. Aedeagus stout, curved, nearly as long as tegumen, unarmed.

Type: Masatierra: Bahía Cumberland (Jan. 7, 1955).

Described from the unique male type.

Family Momphidae

Anchimompha, new genus

Type-species: *Anchimompha melaleuca*, new species.

Antenna about half the length of forewing, somewhat compressed, sparsely ciliate; basal segment without pecten. Labial palpus slightly recurved; second and third segments about equal in length; second segment roughened beneath; third segment acute. Head smooth, ocellus absent; tongue well developed. Hind tibia clothed above with stiff hairlike scales. Forewing smooth, lanceolate, apex long pointed; 11 veins; 1c strongly preserved at margin; 2, 3, 4 well separated; 4 and 5 approximate; 7 and 8 coincident; 6 and 7+8 weakly stalked; 9 approximate to stalk of 6 and 7+8; 11 from beyond middle of cell. Hindwing linear-lanceolate, with 8 veins; 2 remote from 3; 3, 4, 5 about equidistant; 6 and 7 parallel. Abdominal tergites spined.

Female genitalia normal for family, with two signa.

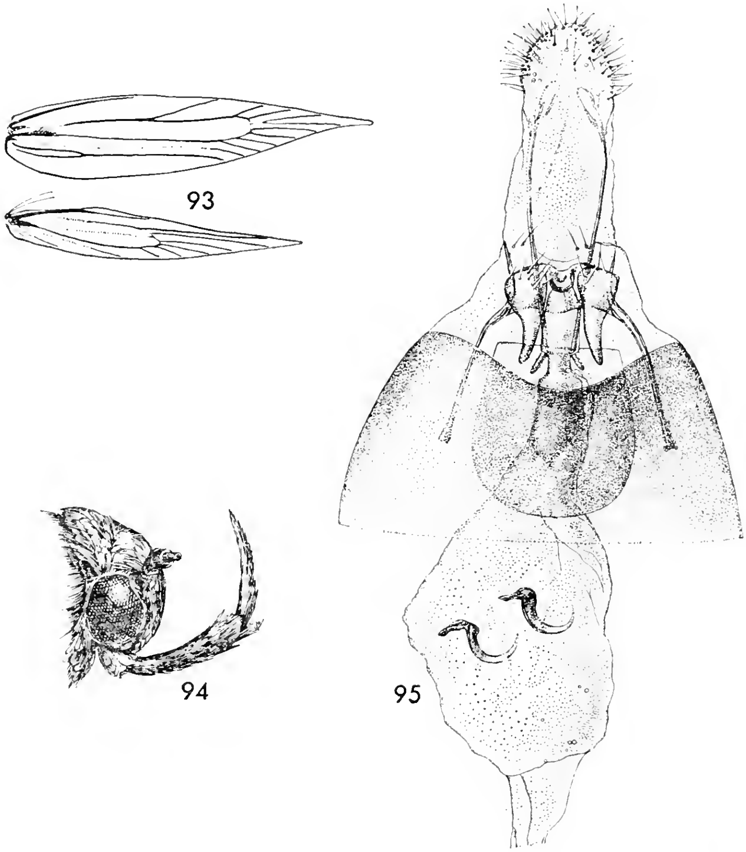
Anchimompha is closely related to *Mompha* as indicated by the female genitalia, but differs from it by the coincident veins 7 and 8 and sharply pointed apex of the forewing. Both genera have vein 1c present in the forewing and the venation of the hindwings is almost identical. Although *Anchimompha* exhibits no antennal pecten as found in *Mompha* the fact remains that a pecten may be reduced to one scale and is easily lost. Fresh specimens might show this character, but in the specimen at hand there is no evidence of a pecten. In my key this genus separates on the alternative "basal segment of antenna without pecten," but because of the fugitive nature of this character it must be used with caution.

***Anchimompha melaleuca*, new species**

Figures 93–95

Alar expanse 14 mm.

Labial palpus ocherous white; second segment suffused with fuscous; distal half of third segment suffused with fuscous. Antenna black. Head ocherous white suffused with fuscous, especially on vertex and face. Thorax blackish fuscous except paler laterally; tegula ocherous white. Forewing black except outer half of costa narrowly ocherous



Figures 93–95.—*Anchimompha melaleuca*, new species: 93, venation of wings; 94, lateral aspect of head to show palpus; 95, ventral view of female genitalia.

white; also, from fold to dorsum ocherous white, this pale color extending along cell and vein 6 to margin; cilia grayish fuscous. Hindwing grayish fuscous; cilia concolorous except they are paler at base. Fore- and midlegs blackish fuscous except tarsi showing some ocherous white. Hindleg ocherous white with some infuscation; tibia with

strong fuscous suffusion on outer side at distal end. Abdomen fuscous above, ocherous white with slight infuscation beneath.

Female genitalia (slide 10758): Ostium membranous preceded by a strongly sclerotized portion of the ductus bursae. Inception of ductus seminalis very large and bursa copulatrix sclerotized posterolaterally to opening. Signa two, strongly sclerotized, sickle shaped.

Type: Masafuera: Quebrada de las Casas (Feb. 7, 1955).

Described from the unique female type.

A note attached to the type bears the following inscription in Dr. Kuschel's hand: "on *Megalachna fernandeziana*" but there is no indication whether the species was found resting on the plant or reared from a larva feeding on it.

Family Blastodacnidae

Genus *Nanodacna* Clarke

Nanodacna Clarke, 1964, Proc. Biol. Soc. Washington, vol. 77, p. 125.

The species of *Nanodacna* are separated by the following key:

Forewing with outer edge of basal patch outwardly oblique from costa to dorsum; cucullus greatly produced and recurved; signa two triangular plates. **ancora** Clarke

Forewing sometimes with basal patch but if so outer edge inwardly oblique, wing with purplish sheen; cucullus truncate; signa two elongate, lightly sclerotized areas with narrow transverse ridge . . . . **indiscriminata,** new species

Nanodacna ancora **Clarke**

FIGURES 96–99

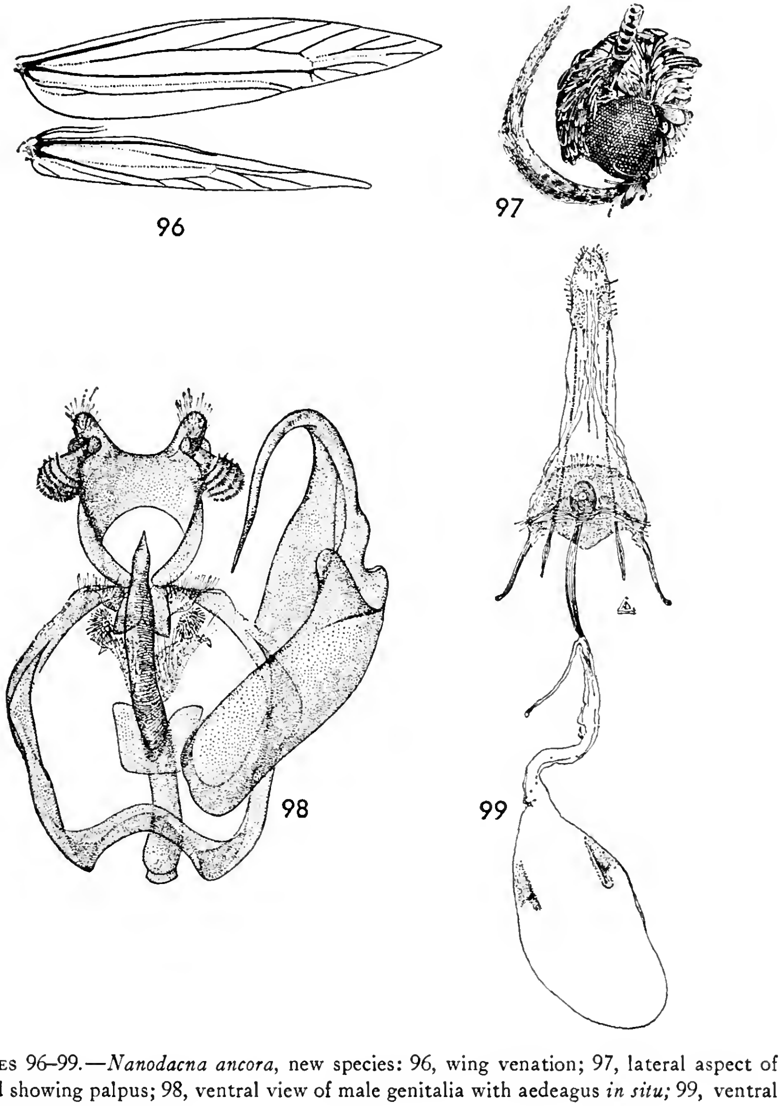
Nanodacna ancora Clarke, 1964, Proc. Biol. Soc. Washington, vol. 77, p. 126.

For completeness' sake I am including the distribution of this species. Masafuera: ♂♀, La Correspondencia, 1150 m. (Jan. 28, 1955); ♂, 3 ♀♀, Quebrada de las Vacas (Jan. 17, 1952); ♀, Quebrada de las Casas (Jan. 17, 1952).

This species differs from the other included species of the genus in several characters but those included in the key distinguish the two most easily.

Since the description of the species, and while still in Chile, the type was destroyed by museum pests. Accordingly, I have selected another specimen, with the same data, as a neotype.

Neotype: Masafuera: ♀, La Correspondencia, 1150 m. (Jan. 28, 1955) (slide 10734) (USNM 67939).



FIGURES 96–99.—*Nanodacna ancora*, new species: 96, wing venation; 97, lateral aspect of head showing palpus; 98, ventral view of male genitalia with aedeagus *in situ;* 99, ventral view of female genitalia.

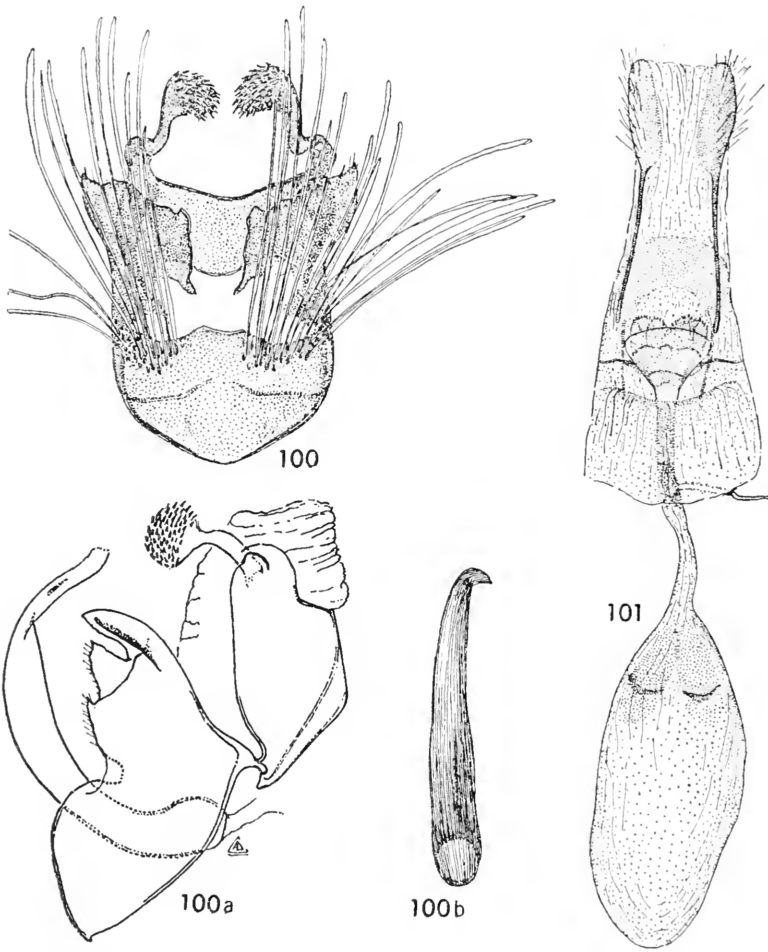
Nanodacna indiscriminata, new species

FIGURES 100–101

Alar expanse 8–13 mm.

Labial palpus creamy white; second segment shaded with fuscous on outer side and distally on inner side; third segment shaded with fuscous on outer side. Antenna fuscous; scape narrowly edged with

creamy white apically. Head variable, gray to grayish fuscous with brassy sheen; face creamy white. Thorax buff to purplish fuscous, when light colored then darker posteriorly; tegula buff to light brown. Forewing (of the type) ground color buff; base of costa narrowly purplish fuscous; from basal sixth of costa to beyond middle a purplish-



FIGURES 100–101.—*Nanodacna indiscriminata*, new species: 100, ventral view of male genitalia with aedeagus removed; 100a, outline drawing of male genitalia in lateral aspect; 100b, aedeagus; 101, ventral view of female genitalia.

fuscous shade extends to dorsum and base of wing, except base is buff costad of fold; slightly beyond basal fourth, in the purplish-fuscous shade, a buff-edged, light brown, oblique oval spot extends almost to costa; also, within the dark shade several longitudinal brown streaks interrupt the solid color; outer half of wing streaked with buff, light brown and purplish fuscous; cilia grayish fuscous. Hind-

wing brassy grayish; cilia grayish fuscous. Legs buff; fore- and mid-legs shaded on outer sides with purplish fuscous; posterior leg shaded on outer side with grayish fuscous. Abdomen shining grayish fuscous above, buff beneath; anal tuft grayish to buff.

Male genitalia (slides 10411, 10445, 10447, 10735, 10760): Harpe broad with bluntly pointed cucullus. Sacculus produced as a bluntly pointed, short process. Vinculum rounded with a group of long, slender scales from each side. Anellus very lightly sclerotized and poorly defined. Aedeagus curved, distally flattened. Gnathos consisting of two long processes dilated and spined distally.

Female genitalia (slides 10722, 10736, 10737, 10757, 10759): Ventral lip of ostium broadly expanded, posterior edge finely serrate. Inception of ductus seminalis from a median sclerotized portion of the ductus bursae. Signa two elongate, lightly sclerotized areas with transverse ridge.

Type: Masatierra: Piedra Agujereada (Mar. 12, 1955).

Described from the type female, ten male and eight female paratypes as follows: 2 ♂♂, 2 ♀♀, Alto Francés, 500 m. (Mar. 2, 1951); ♂, Cerro Alto, 600 m. (Feb. 1, 1952); ♂, El Pangal, 350 m. (Feb. 18, 1951); 2 ♂♂, 4 ♀♀, La Mona, 400–475 m. (Feb. 16, 1951, Jan. 30, 1955); 2 ♂♂, 2 ♀♀, Plazoleta del Yunque, 200 m. (Feb. 9, 1952); 2 ♂♂, Salsipuedes, 400 m. (Mar. 5, 1951).

A female has been selected as type because it is in good condition and is, perhaps, more nearly representative of the average for the species. At best, *indiscriminata* is extremely variable, ranging from a nearly immaculate brownish shade to specimens with the basal two-thirds of the forewing purplish fuscous and the outer third buff or light brown with a few, scattered dark scales. One female has a tawny forewing with a broadly triangular purplish-fuscous area occupying the costal two-thirds except for the base and apex.

The two species of this genus are similar in appearance but each is endemic on its own island and is easily distinguished by genitalic characters.

Family Hyponomeutidae

Genus *Plutella* Schrank

Plutella maculipennis (Curtis)

Cerostoma maculipennis Curtis, 1832, British entomology, vol. 6 (Lepidoptera 2), pl. 420 (expl. p. 2).

Distribution: Santa Clara: El Corral, ♂, 2 ♀♀ (Jan. 6, 1952); Masafuera: Quebrada de las Casas, ♂, ♀ (Jan. 19, 1952).

A common pest of cruciferous plants rather generally distributed throughout most of the world.

Genus *Melitonympha* Meyrick

Melitonympha Meyrick, 1927, Exotic Microlepidoptera, vol. 3, p. 360.

Type-species: *Melitonympha heteraula* Meyrick, ibid. [by monotypy].

Melitonympha cockerella (Busck)

Abebaea cockerella Busck, 1903, Journ. New York Ent. Soc., vol. 11, p. 54.
Melitonympha heteraula Meyrick, 1927, Exotic Microlepidoptera, vol. 3, p. 360. —Clarke, 1965, Catalogue of the type specimens of Microlepidoptera in the British Museum (Natural History) described by Edward Meyrick, vol.5, p. 347, pl. 172, figs. 1–1c.

Melitonympha is, perhaps, most nearly related to the two South American mainland genera *Chalconympha* Meyrick and *Thalassonympha* Meyrick, but also shows a relationship to the more widely distributed *Cerostoma*. The three genera *Melitonympha*, *Chalconympha*, and *Thalassonympha* all have in common stalked veins 7 and 8 of the forewing but in *Cerostoma* these veins are separate. *Melitonympha*, *Chalconympha* and *Cerostoma* have veins 6 and 7 of hindwing stalked but in *Thalassonympha* these veins are well separated and nearly parallel. In both *Melitonympha* and *Chalconympha* the maxillary palpi are well developed but in *Thalassonympha* they are obsolete. All three possess a well-developed antennal pecten.

The male genitalia are normal for the family. Socii and gnathos present and well developed.

Perhaps the presence of this North American genus in the Juan Fernandez Islands may be surprising but I have already demonstrated the presence of *Martyrhilda* (Oecophoridae), another genus described from North America, on Masatierra (plus five species in this genus on the South American mainland). At this time I have on hand an additional undescribed species of *Melitonympha* from Chile and this genus may be much more widespread than presently indicated.

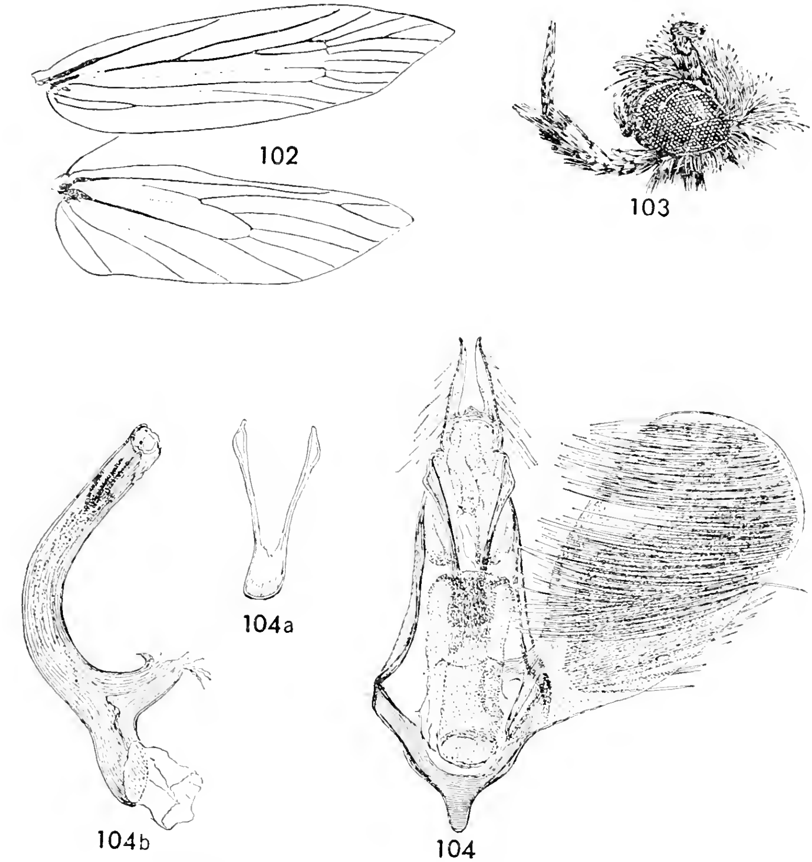
Melitonympha telluris, new species

Figures 102–104

Alar expanse 16 mm.

Labial palpus ocherous white; second segment with brownish suffusion on outer side. Antenna brownish with narrow, shining ocherous-white annulations. Head ocherous white with mixture of a few brownish scales. Thorax and ground color of forewing ocherous white; thorax and basal half of tegula shaded with pale argillaceous; forewing irregularly blotched and shaded with argillaceous; veins in costal half of wing indistinctly indicated by ill-defined,

longitudinal, brownish streaks; basal half of dorsum narrowly fuscous; at end of cell, between veins 3 and 5 a fuscous spot; entire surface of wing sparsely and irregularly irrorate with fuscous; cilia ocherous white. Hindwing sordid white shading to pale gray apically; cilia sordid white. Legs ocherous white; foreleg shaded with fuscous on outer side. Abdomen grayish above, ocherous white beneath.



FIGURES 102–104.—*Melitonympha telluris*, new species: 102, venation of wings. 103, lateral aspect of head showing palpus; 104, ventral view of male genitalia with left harpe and aedeagus removed; 104a, ventral view of gnathos; 104b, lateral aspect of aedeagus.

Male genitalia (slide 10442): Harpe simple, very broad; cucullus rounded. Vinculum rather narrow; saccus short, bluntly pointed. Gnathos spoon shaped apically. Socii slender, digitate. Aedeagus strongly curved with dorsobasal protuberance for entrance of vesica; vescia armed with three prominent cornuti.

Type: Masatierra: Alto Inglés, 600 m. (Feb. 6, 1952).

755–910—65——7

Described from the unique type male. This species has no known near relatives.

Eudolichura, new genus

Type-species: *Eudolichura exuta*, new species, by monotypy and present designation.

Antenna slightly more than half the length of forewing, simple (male not known); scape without pecten. Labial palpus only slightly curved, more than three times as long as head; second and third segments about equal in length and both somewhat roughened beneath but second segment without any brush. Head roughened with dense scales above; ocellus present, very small, posterior; tongue well developed; maxillary palpus moderate, slender, ascending. Hindtibia moderately stout, smooth dorsally, roughened beneath. Forewing with 12 veins, all veins separate; 2 well before angle of cell, three times as far from 3 as 3 is from 4; other veins well separated; accessory cell present. Hindwing with 8 veins; 2 remote from 3; 3 and 4 well separated; 5 and 6 stalked; 6 and 7 nearly parallel; hair pencil present on base of wing.

Female genitalia without signum.

Eudolichura appears to have its affinities with the New Zealand genera *Orthenches* Meyrick and *Protosynaema* Meyrick. *Eudolichura* can be distinguished from *Orthenches* by the rough-scaled head, absence of antennal pecten and the stalked condition of veins 5 and 6 of the hindwing. The only significant differences between *Eudolichura* and *Protosynaema* are the stalking of veins 5 and 6 of the hindwing of *Eudolichura*, absent in *Protosynaema*, and the presence of a dense clothing of scales on the basal portion of the antenna of *Protosynaema*, absent in *Eudolichura*. The most nearly allied South American genus appears to be *Calliathla* Meyrick, described from Lake Nahuel Huapi, Territory Río Negro, Argentina. This genus exhibits the same venation as *Eudolichura* (5 and 6 of hindwing stalked; *not* separate as characterized by Meyrick), but differs from it by the presence of a well-developed antennal pecten, approximate veins 9 and 10 of forewing and the very oblique discocellulars of hindwing. *Calliathla* is also a much narrower winged genus.

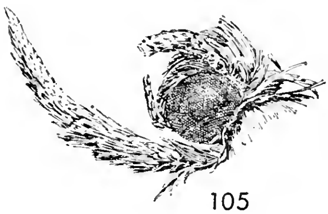
Eudolichura exuta, new species

FIGURES 105–107

Alar expanse 19 mm.

Labial palpus buff; second segment shaded with brown on outer side. Antenna fuscous with pale annulations; scape and head pale ochraceous tawny. Thorax brown; tegula buff tipped. Forewing brown becoming lighter toward costa; extreme base of costa narrowly

fuscous; along costa to apex a series of small, ill-defined brownish spots; dorsum buff infuscated toward edge, the buff forming an undulating line at junction with the ground color; at end of cell, at base of vein 8, a few blackish scales; between the end of cell and apex a subrectangular buff blotch containing a few scattered brownish scales; on tornus a few brown spots; area inside termen narrowly



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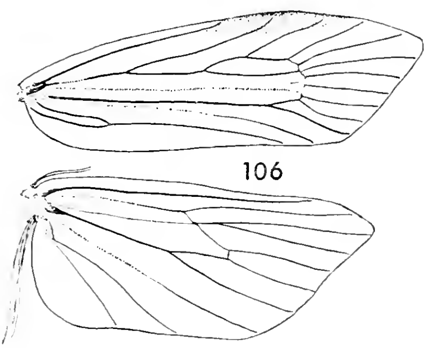

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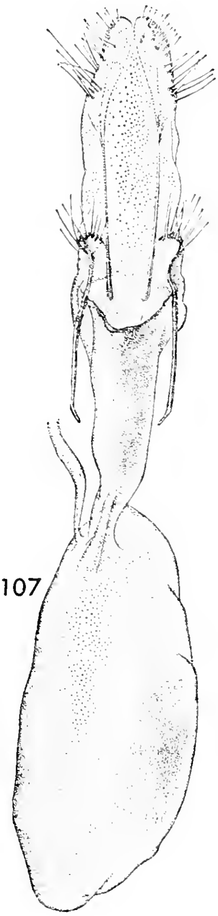

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FIGURES 105–107.—*Eudolichura exuta*, new species: 105, lateral aspect of head to show palpus; 106, venation of wings; 107, ventral view of female genitalia.

and indistinctly buff; cilia alternating buff and brown groups forming ill-defined spots. Hindwing buff, shading to brownish apically; cilia buff. Legs buff, shaded with ochraceous tawny; tarsi broadly banded with fuscous. Abdomen buff, lightly suffused with fuscous; anal tuft dull ocherous; seventh sternite with pronounced callosity.

Female genitalia (slide 10764): Ostium broad, with narrowly

sclerotized edge. Ductus bursae wholly membranous; inception of ductus seminalis at posterior edge of bursa copulatrix.

Type: Masafuera: La Correspondencia, 1200 m. (Feb. 16, 1955).

Described from the unique female type. Although generically distinct, *exuta* bears a strong superficial resemblance to *Leuroperna leioptera* but the latter is much darker in coloration.

Leuroperna, new genus

Type-species: *Leuroperna leioptera*, new species, by monotypy and present designation.

Antenna slightly more than half the length of forewing, serrate, thickened in male; scape with pronounced scale-flap. Labial palpus curved, ascending, second segment about two-thirds the length of third, with conspicuous ventroanterior triangular brush; third segment slender, acute. Head roughened by erect scales on crown; face smooth but bordered laterally by elongate scales. Maxillary palpus well developed, slender, porrect. Hindtibia slender, smooth. Forewing with 12 veins, all separate; 2 distant from 3; 3 and 4 approximate; 6, 7, 8, and 9 about equidistant; 11 from before middle of cell. Hindwing with 8 veins; 2 remote from 3; 3 and 4 connate; 5 nearer to 6 than to 4; 6 and 7 subparallel; hair pencil present at base of wing.

Male genitalia without uncus or gnathos. Ventrolateral hair pencil present.

Female genitalia without signum.

In general appearance *Leuroperna* is similar to *Eudolichura*, described herein, and to *Plutella* Schrank. *Leuroperna* differs from *Eudolichura* by the presence of a pronounced scale-flap on scape, porrect maxillary palpus, connate veins 3 and 4 and separate veins 5 and 6 of hindwing. From *Plutella* the genus *Leuroperna* can be distinguished by the presence of a well-developed accessory cell in forewing, connate veins 3 and 4 and separate veins 5 and 6 of hindwing.

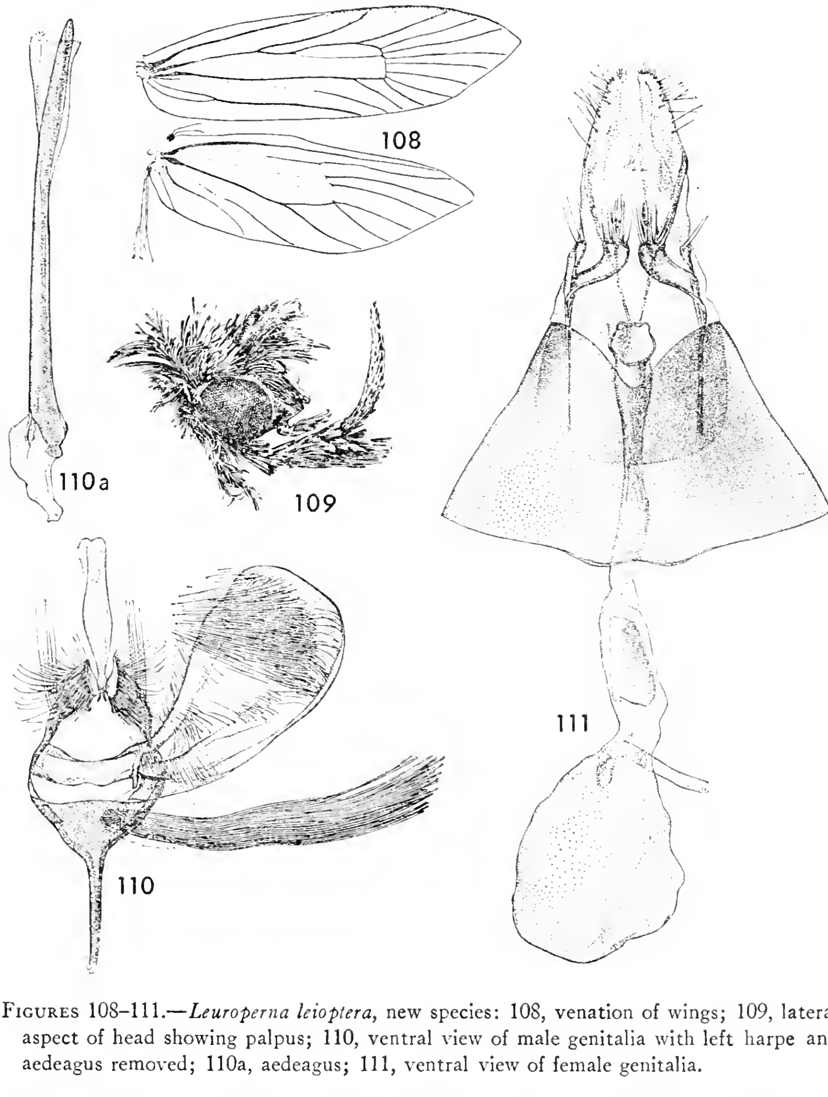
Leuroperna leioptera, new species

Figures 108–111

Alar expanse 20–22 mm.

Labial palpus ivory white; second segment shaded with grayish fuscous on outer side; third segment shaded with grayish fuscous anteriorly and on outer side. Antenna with scape fuscous, remainder becoming lighter to middle then, progressively, 3–4 segments blackish followed by 3 ivory white, 6 blackish, 2 ivory white, 3 blackish, ivory white and terminal 5 grayish fuscous. Head grayish to fuscous; crown ivory white to buff. Thorax buff with a blackish-fuscous, longitudinal stripe on each side; tegula fuscous mixed with a few

buff scales, the whole with a violaceous sheen. Ground color of forewing tawny olive infuscated with grayish toward costa and dorsum; extreme costa buff; a double row of small spots paralleling costa, blackish fuscous, these spots partly edged with white scales; at middle of costa a somewhat larger spot extends almost to cell;



Figures 108–111.—*Leuroperna leioptera*, new species: 108, venation of wings; 109, lateral aspect of head showing palpus; 110, ventral view of male genitalia with left harpe and aedeagus removed; 110a, aedeagus; 111, ventral view of female genitalia.

from apex, around termen and along dorsum a series of blackish-fuscous spots diminishing in size from apex to basal fourth of dorsum; the apical and two terminal spots each with a cluster of white scales; base of forewing blackish fuscous, this color continued as an undulating

shade obliquely curved to near dorsum, thence to near center of cell, curved again toward dorsum and continued around to end of cell and outwardly along vein 6; this undulating shade is lightened somewhat outwardly by the ground color; the dark shade edged with white scales for part of its length; the dark tornal area separated from the dark median color by a curved, buff line, the latter with some scattered white scales; on fold, at about two-fifths, a double, blackish-fuscous spot, the parts separated by white scales; cilia grayish fuscous mixed with whitish and buff scales. Hindwing gray with brassy sheen; cilia grayish fuscous, except at apex, buff, with darker subbasal band. Legs buff; fore- and midlegs broadly banded with blackish fuscous; hindleg tibia gray outwardly; tarsi broadly banded with blackish fuscous. Abdomen grayish fuscous; dorsally, first three segments mostly buff and succeeding segments edged with buff dorsally; ventral longitudinal stripe and anal tuft dull ocherous.

Male genitalia (slide 10763): Harpe ample, triangular, broadened apically, simple. Vinculum broadened ventrally; saccus slender, about half as long as harpe. Socii large flaps heavily clothed with long hairlike setae. Aedeagus slender, slightly curved, pointed, unarmed.

Female genitalia (slide 10762): Ostium round, funnicular, sclerotized, tapering into ductus bursae. Ductus bursae with an elongate sclerotized area adjacent to bursa copulatrix. Inception of ductus seminalis from posterior edge of bursa copulatrix.

Type: Masafuera: La Correspondencia, 1150 m. (Jan. 28, 1955).

Described from the type male and three female paratypes all with the same data.

All of the specimens have one or the other pair of wings damaged apically but are otherwise in good condition.

Family Glyphipterygidae

Genus *Brenthia* Clemens

In this collection there is a single female specimen belonging to this family. The specimen is worn, possesses part of one labial palpus and is not in sufficiently good condition to warrant description. The specimen measures 9.5 mm. in alar expanse and probably belongs to the genus *Brenthia*.

The locality is: Masatierra: Cerro Alto, 600 m. (Feb. 1, 1952).

Family Psychidae

Plate 1

Of this family there is a single representative which, at this time, cannot be assigned to genus or species.

Bag of unknown species of Psychidae

To the outside of the case, small pieces of twigs and the thick leaves of the food plant are attached. These fragments are distributed unevenly over the surface in an attractive manner, the grayish-white pieces of leaves contrasting with the darker body of the bag.

The single specimen was collected on: Masatierra: Alto Pangal, 450 m. (Feb. 8, 1952).

Food plant: *Pernettya rigida* (Bert.) DC.

Family Tineidae

Genus *Monopis* Hübner

Monopis crocicapitella (Clemens)

Tinea crocicapitella Clemens, 1860, Proc. Acad. Nat. Sci. Philadelphia, 1859, p. 258.

Distribution: Masatierra: Bahía Cumberland, 3 ♂♂ (Feb. 17, 1951, Mar. 6, 1955, Mar. 10, 1955).

Another common, widely distributed insect which we can expect to find in almost any human habitation. Since it also attacks fur of dead animals, and other animal matter in the wild state, its distribution is practically unlimited.

Genus *Trichophaga* Ragonot

Trichophaga tapetzella (Linnaeus)

Phalaena Tinea tapetzella Linnaeus, 1758, Systema naturae, ed. 10, p. 536.

Distribution: Masafuera: Quebrada de las Vacas, ♀ (Jan. 17, 1952).

The single female recorded above is the only specimen I have seen from the islands.

Genus *Lindera* Blanchard

Lindera tessellatella Blanchard

Lindera tessellatella Blanchard, 1852, *in* Gay, Historia fisica y politica de Chile, Zoologia, vol. 7, p. 106.

Type: Museum National d'Histoire Naturelle, Paris.

Type locality: Las Cordilleras de Elqui, Chile.

Distribution: Masatierra: Bahía Cumberland, ♂, 6 ♀♀ (February to March dates 1951, 1955); Masafuera: Quebrada de las Casas, 2 ♂♂, ♀ (Jan. 23 to Feb. 19, 1955; female marked "en habitacíon").

Although the species was described from Chile it is now recorded from such widely separated places as California, Montana, Mexico, Fiji Islands, Australia, and New Zealand.

Genus *Tinea* Linnaeus

Tinea pallescentella Stainton

Tinea pallescentella Stainton, 1851, A supplementary catalogue of the British Tineidae and Pterophoridae, p. 2.

Tinea stimulatrix Meyrick, 1931, Anales del museo nacional de historia natural, Buenos Aires, vol. 36, p. 413 (new synonymy).

Tinea horosema Meyrick, 1931, Anales del museo nacional de historia natural, Buenos Aires, vol. 36, p. 413 (new synonymy).

Types: British Museum (Natural History).

Type localities: England (*pallescentella*); Argentina, Territory Río Negro, Bariloche (*stimulatrix*); Argentina, Territory Río Negro, Lake Nahuel Huapi (*horosema*).

Distribution: Masatierra: Villagra, ♂ (Feb. 22, 1951): Santa Clara: El Corral, 2 ♀♀ (Jan. 6, 1952).

In view of the rather large proportion of microlepidoptera introduced into these islands, it is not surprising to find *pallescentella* among their number.

As indicated in the synonymy, the species has already been recorded from the South American continent under two different names: *stimulatrix* and *horosema*. No doubt the apparent variability of this species led Meyrick astray, but if he had considered the possibility of the specimens having been collected at some lodging, other than in the native state of the little-known Río Negro area, he would have recognized this rather widely distributed species.

Mr. Bradley, of the British Museum, has kindly examined this material and has confirmed my identification of *pallescentella*. His remarks are as follows: "No. 10440, 10441, 10765 are *Tinea pallescentella*. It seems to me that *T. horosema* Meyr. (♀) and *T. stimulatrix* Meyr. (♂) are no more than *pallescentella*. The superficial differences are no help as *pallescentella* varies. The genitalia differences are slight and I think due to individual variation. For example, the internal sclerotization in the aedeagus is small and could be expected to vary. The depth of the medial incision of the ostial plate does seem more variable than might be expected (assuming that it is variation in one species). It is impossible to be quite certain without looking at more specimens but I think I can safely say that your material belongs to *pallescentella* and that *horosema* and *stimulatrix* may prove to be no more than *pallescentella*."

Family Oinophilidae

Genus *Oinophila* Stephens

Oinophila v-flava (Haworth)

Gracillaria v-flava Haworth, 1811, Lepidoptera Britannica, pt. 4, p. 530.

Distribution: Masatierra: Bahía Cumberland, 4 ♂♂, 4 ♀♀ (Feb. 17, 1951 to Mar. 13, 1955); La Mona, 400 m., ♂, ♀ (Feb. 16, 1951).

Usually the larva of this species is recorded in Europe as feeding on fungi in cellars and on molds on the corks of wine bottles. There is one specimen in this present collection marked "Grutas de las Patriotas" which suggests conformation with European habits of this insect but in Western United States the species has been recorded from *Baccharis*.

Tinea pellionella Linnaeus

Phalaena Tinea pellionella Linnaeus, 1758, Systema naturae, ed. 10, 536.

Distribution: Masatierra: Bahía Cumberland, ♂ (Feb. 3, 1952). Masafuera: Quebrada de las Casas, ♂ (Jan. 16, 1952).

In recording this species I do so with some misgivings. Although we should expect to find *pellionella* in these islands, along with species with similar habits, these specimens are not exact matches for what we generally consider to be normal *pellionella*. On the other hand, the series at the U.S. National Museum and at the British Museum, show considerable variation for this variable species. Certainly the two examples before me do not approach in character any other known form and they do not warrant description as a distinct taxon.

Family Lyonetiidae

Genus *Bedellia* Stainton

Bedellia somnulentella (Zeller)

Lyonetia somnulentella Zeller, 1847, Isis von Oken, vol. 12, p. 894.

Distribution: Masatierra: Bahía Cumberland, 6 ♂♂, 4 ♀♀ (Jan. 7 to Mar. 14, 1951–1955). Masafuera: Quebrada de las Vacas, ♀ (Jan. 17, 1952).

This common and widespread pest of sweet potato and other allied plants is another of the species carried and distributed through commerce. Its presence in the Juan Fernandez Islands was to be expected.

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NEOTROPICAL HEMEROBIIDAE IN THE UNITED STATES NATIONAL MUSEUM

By Waro Nakahara [1]

Introduction

In this paper I present the results of my studies on the Central and South American Hemerobiidae in the collection of the U.S. National Museum. The greater part of this material, consisting of some 200 specimens, has not hitherto been studied although several of the specimens have been previously determined by Banks, Parfin, Townes, or Gurney.

Of the 27 species contained in the collection, 19 are documented here, including 5 that are new and 1 representing a new genus. Eight other species could not be determined specifically because of insufficient material or for other reasons. These, together with the overwhelming majority of some 70 species previously described from the Neotropical region, but not recognized in the material examined, are not included. Many of the older species are described so inadequately that their identification is practically impossible, and this situation is likely to prevail until someone locates the types and makes known the anatomy of the male genitalia.

I wish to thank Dr. Oliver S. Flint, Jr., of the U.S. National Museum, not only for his kindness in permitting me to examine the

[1] 1141 Mejiro, Toshima-ku, Tokyo, Japan.

material upon which this paper is based, but also for making important suggestions about the identity of some of the species. The material credited to J. F. G. Clarke was collected with the aid of a National Science Foundation grant.

Subfamily Natiobiellinae

Genus *Notiobiella* Banks

Notiobiella rubrostigma Navás

Notiobiella rubrostigma Navás, Broteria, Ser. Zool., vol. 12, p. 228, 1914.

One ♀, Almirante, Panama, Nov. 24, 1952 (F. S. Blanton), in alcohol. One specimen, pinned, without abdomen, San Salvador, El Salvador, without date (P. A. Berry).

These specimens are compatible with the description of *rubrostigma* Navás as well as with that of *callangana* Kimmins (Ann. Mag. Nat. Hist., ser. 11, vol. 6, p. 227, fig. 5, 1940), and I tentatively list them under the older name. It is impossible to tell whether or not this is the same as *callangana* Kimmins since the only difference given by Kimmins concerns the shape of the anal plate of the male.

Forewing nearly 6 mm. long; membrane tinged with brownish and with three perceptibly lighter zones across the wing. Costal crossveins partially fuscous, those near base and humeral recurrent vein totally fuscous; basal subcostal crossvein, crossvein between Cu_1 and Cu_2, and crossvein connecting first and second radial sectors near base of latter distinctly marked with dark brown; forks of longitudinal veins marked with light brown. Pterostigmatic region containing a carmine red spot contiguous to subcosta. Length of hindwing 4 mm.; pterostigmatic area elongated and totally carmine red; a single discal crossvein between R_{4+5} and M_{1+2}, not between M (procubitus) and Cu_1 as given in Navás' original description, probably erroneously.

Subfamily Hemerobiinae

Genus *Sympherobius* Banks

Sympherobius barberi (Banks)

Hemerobius barberi Banks, Proc. Ent. Soc. Washington, vol. 3, p. 241, 1903.

Sympherobius barberi Banks, Trans. Amer. Ent. Soc., vol. 32, p. 42, 1905.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 235, fig. 35, pl. 1, fig. 9, 1940.

One ♂, Sonora, Mexico (P. H. Arnaud); 1 ♀, Cuernavaca, Mexico (N. L. H. Krauss); 1 ♀, Tejupilco, Mexico, June 20, 1933 (H. E. Hinton and R. L. Usinger); 7 specimens, Mexico, with no further datum; 1 ♂, Monterey, Mexico (E. A. Schwarz); 1 ♀ and another specimen without abdomen, Clarión Island, Mexico (H. H. Keifer);

1 ♂, 2 ♀, and 2 other specimens without abdomen, Socorro Island Mexico, (H. H. Keifer); 2 specimens, Piura, Peru (R. A. Berry); 2 specimens, Lima, Peru; 4 specimens, Arequipa, Peru.

This is the most common species of the genus in southern United States and its occurrence in territories farther south is only to be expected. The records from the small islands of Socorro and Clarión may be noteworthy.

Sympherobius angustus (Banks)

Hemerobius angustus Banks, Trans. Amer. Ent. Soc., vol. 30, p. 102, 1904.
Sympherobius angustus Banks, ibid., vol. 32, p. 41, 1905.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 233, fig. 34, pl. 2, fig. 16, 1940.
Sympherobius tristis Navás, Bull. Brooklyn Ent. Soc., vol. 9, p. 15, fig. 2, 1914.

One ♀, Cuernavaca, Mexico, July 1906 (Wm. Schaus), bearing Banks' label ("*Sympherobius angustus* Bks."); 1 ♀, Real de Arriba, Temescaltepec, Mexico (H. E. Hinton and R. L. Usinger); 1 specimen without abdomen, 10 miles south of Jalapa, Mexico (G. E. Bohart).

I refer these specimens to *angustus*. Forewing 5 mm. in length, very slender with very narrow costal space. Color as well as venational characters are compatible with this determination.

Sympherobius arizonicus Banks

Sympherobius arizonicus Banks, Trans. Amer. Ent. Soc., vol. 37, p. 346, 1911.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 234, pl. 2, fig. 14, 1940.

One ♀, 18 miles southeast of Guaymas, Sonora, Mexico (R. Ryckman, C. Christianson, and R. Lee).

The very characteristic brown maculation of forewing strongly suggests that the specimen may be *arizonicus*, which has hitherto been known from the unique female type from Arizona.

Sympherobius maculipennis Kimmins

Figure 1; Plate 1 (Fig. 1)

Sympherobius maculipennis Kimmins, Rev. Soc. Ent. Argentina, vol. 9, p. 189, text fig. 3, pl. fig. 1, 1929.

One ♂, Mendoza (Argentina?), Apr. 13–15, 1921, "feeding on coccus on *C. aethiops*"; 1 ♀, Pelotas, Rio Grande do Sul, Brazil, May 10, 1956 (C. Biezanko); 3 ♂ and 1 ♀, Uruguay near Montevideo, May 24, 1946 (P. A. Berry); 1 ♀, Verrugas, Lima, Peru, May 19, 1928 (R. C. Shannon); 1 ♂, in alcohol, Pelotas, Brazil, February 1955 (C. Biezanko), determined by S. Parfin as "near *Sympherobius maculipennis* Kimmins."

Kimmins figured the lateral view of the abdominal apex of the male without giving any description. The structures shown in solid

black in his figure are parts of anal plate and are very characteristic in this species.

Anal plate consisting of two pieces: the upper part, occupying usual position of the plate, narrowly but exceedingly highly sclerotized on the ventrodistal border and produced into a needle-like projection; lower part subquadrate in lateral view with a dorsal projection about equal in length to that of upper part. Lower part apparently corresponding to "internal flap" found in many species of this genus, however, occupying a position ventral to the main body of anal plate. Tenth sternite of the usual type. Paramere with a large spatulate head, which is ventrally bipartite and slightly upturned distally; the fused anterior part about twice as long as the spatulate head. Ninth sternite, forming a short subgenital plate, smaller than average for the genus, but not so small as represented in Kimmins' figure.

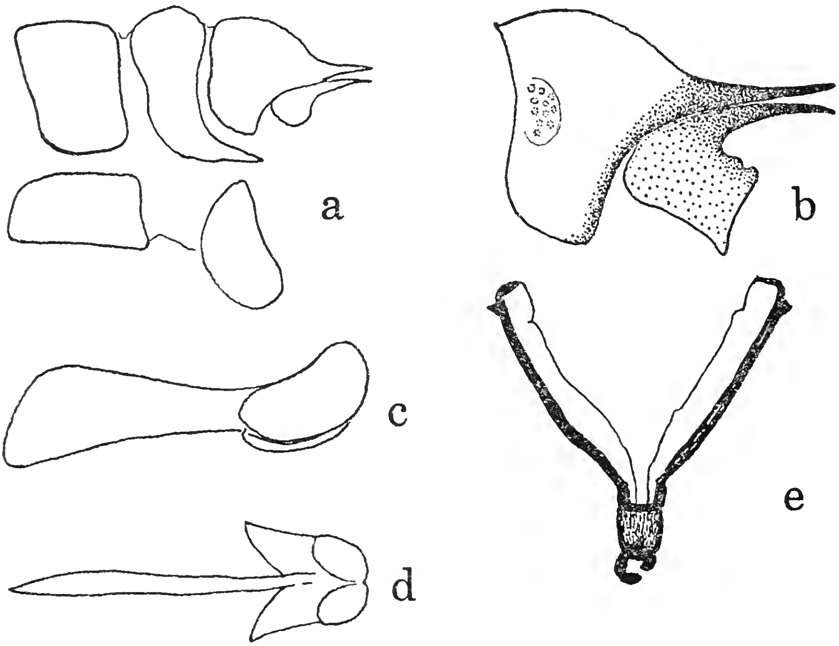


FIGURE 1.—*Sympherobius maculipennis* Kimmins (male genitalia): *a*, apex of abdomen, lateral view; *b*, anal plate, lateral view; *c*, parameres, lateral view; *d*, parameres, dorsal view; *e*, 10th sternite, dorsal view.

The unique structure of the anal plate strongly suggests that this species should be separated generically from *Sympherobius*, and this idea is supported by venational characters, which show essential agreement with those of *Sympheromima* Kimmins ("Eos," Rev. Espan. Ent., vol. 4, p. 363, 1928). Thus, the first branch of the radial sector and media are forked more than once before the outer

gradates, and there are five and six crossveins, respectively, to the outer and inner gradate series. Cu_1 is more heavily branched than in the typical *Sympherobius*, and the first and second branches, with the sixth crossvein of the inner gradate series, form a closed cell, the like of which is not found in any species of true *Sympherobius*. In *maculipennis* the first radial sector is often split into two as in the case of the individual shown in plate 1 (fig. 1). Unfortunately *Sympheromima marginata* Kimmins, the sole species and the type of the genus, was described from a single specimen lacking an abdomen, and hence nothing is known of its genitalic characters. This circumstance makes it difficult to place *maculipennis* under *Sympheromima* with assurance, and I retain this species in *Sympherobius* for the present.

Genus *Nomerobius* Navás

Nomerobius psychodoides (Blanchard)

Megalomus psychodoides Blanchard, *in* Gay, Hist. Chile, Zool., vol. 6, p. 127, 1861.

Sympherobius modestus Banks, Proc. Ent. Soc. Washington, vol. 12, p. 158, 1910.

Nomerobius psychodoides Navás, Mem. R. Acad. Cien. Art. Barcelona, vol. 12, p. 131, 1915.—Nakahara, Mushi, vol. 34, p. 22, figs. 31–34, pl. 8, fig. 16, 1960.

One ♂, Bariloche, Río Negro, Argentina, November 1926 (R. and E. Shannon), bearing Banks' label "*Nomerobius modestus* Bks."; 1 ♂, Valparaíso, Chile (Cockerell).

This species was fully described very recently (Nakahara, loc. cit.).

Nomerobius marmoratus (Navás), new combination

Sympherobius marmoratus Navás, Broteria, Ser. Zool., vol. 9, p. 70, 1910.—Kimmins, Rev. Soc. Ent. Argentina, vol. 9, p. 188, fig. 2, 1929.—Nakahara, Mushi, vol. 34, p. 20, pl. 7, fig. 14, 1960.

Two ♀, Argentina (without further locality data), May 25, 1927.

This species should be placed under *Nomerobius* because of the long, interrupted series of outer gradate crossveins, the apical series consisting of three or four and the posterior series of two or three crossveins, with an interruption between the two series. The inner gradate series consists of four crossveins.

Genus *Pseudomicromus* Krüger

Pseudomicromus subanticus (Walker)

Hemerobius subanticus Walker, List Neuroptera Brit. Mus., vol. 2, p. 282, 1853.

Micromus angustus Hagen, Proc. Boston Soc. Nat. Hist., vol. 23, p. 287, 1886.

Micromus subanticus.—Banks, Trans. Amer. Ent. Soc., vol. 32, p. 46, 1906.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 250, fig. 53, pl. 2, fig. 22, 1940.

Micromus nesoticus Navás, Brooklyn Ent. Soc., vol. 9, p. 16, fig. 3, 1914.
Pseudomicromus subanticus.—Nakahara, Mushi, vol. 34, p. 32, figs. 62–64, 1960.

One ♀, Mexico at Brownsville, Tex., Gateway Bridge, Mar. 9, 1937, in alcohol. This specimen was determined by A. B. Gurney as "*Micromus subanticus* (Walker)."

Pseudomicromus variolosus (Hagen)

Micromus variolosus Hagen, Proc. Boston Soc. Nat. Hist., vol. 23, p. 284, 1886.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 251, fig. 54, pl. 2, fig. 21, 1940.
Pseudomicromus variolosus.—Nakahara, Mushi, vol. 34, p. 32, 1960.

One ♀, Mexico, May 12, 1943, on parsley, determined as "*Micromus variolosus*" by H. Townes.

Pseudomicromus fuscatus, new species

Plate 1 (Fig. 2)

Holotype ♀, Real de Arriba, Temescaltepec, Mexico, May 23, 1933 (H. E. Hinton and R. L. Usinger). Right wings mounted dry on a slide, USNM type 66866.

Length of body 6.5 mm.; length of forewing 8.5 mm.; width 2.5 mm.; length of hindwing 7 mm.

Head, thorax, and abdomen nearly uniformly very dark grayish brown, almost blackish; antennae nearly black; legs slightly paler.

Forewing very slender, produced into subacute apex; membrane unspotted, almost uniformly tinged with light brown, slightly more intensely toward apical and hindmarginal areas and in the narrow mediocubital cell; pterostigmatic area more brownish; venation wholly dark brown. Four or five branches to radius; M_{3+4} and Cu_1 connected by a very short crossvein; five or six crossveins to inner and seven to outer gradate series, these crossveins being separate from each other by more than their length; radius, two gradates, and outer margin of the wing nearly parallel and about the same distance apart. Hindwing hyaline, slightly brownish toward apex, with brownish pterostigmatic area; veins, including gradate crossveins, all brownish; M_{3+4} not running into Cu_1.

The large size, narrow forewing with subacute apex, and almost uniformly brownish membrane form a combination of characters that readily distinguishes this species. I tentatively place it in the genus *Pseudomicromus* on the assumption that it may be related to *subanticus* and *variolosus*, but examination of male genitalia is required to confirm this generic designation.

Genus *Ameromicromus* Nakahara

Ameromicromus posticus (Walker)

Hemerobius posticus Walker, List Neuroptera Brit. Mus., pt. 2, p. 283, 1853.
Micromus insipidus Hagen, Smithsonian Misc. Coll., vol. 4, art. 1, p. 199, 1861.
Micromus sobrinus Hagen, loc. cit.
Micromus posticus.—Banks, Trans. Amer. Ent. Soc., vol. 32, p. 45, 1905.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 248, fig. 51, 1940.
Ameromicromus posticus.—Nakahara, Mushi, vol. 34, p. 33, figs. 68–70, 1960.

One ♂ and 1 ♀, Tamazunchale, San Luis Potosí, Mexico (G. E. Bohart); 1 ♂, 26 miles east of Ciudad del Maiz, San Luis Potosí, Mexico (H. B. Leech).

I am not aware of any previous record from Mexico of this common Nearctic species.

Genus *Nusalala* Navás

Nusalala colombiensis (Banks)

Boriomyia colombiensis Banks, Proc. Ent. Soc. Washington, vol. 12, p. 157, 1910.
Nusalala colombiensis.—Kimmins, Ann. Mag. Nat. Hist., ser. 10, vol. 17, p. 576, 1936.

One ♀ (syntype), San Antonio, 2000 m., western Colombia (Fassl), determined by Sophy Parfin as *Nusalala colombiensis* (Banks).

The forewing is distinctively marked but the specimen before me is discolored by adherent extraneous matter.

Nusalala krügeri, new species

FIGURE 2; PLATE 1 (FIG. 3)

Holotype ♂, Córdoba, Mexico, Jan. 1, 1941 (G. E. Bohart). Right wings (dry) and dissected parts of genitalia (in balsam) mounted on two slides, USNM type 66867.

Face fulvous, with a large black spot in middle of frons; brownish around antennal socket and continued to vertex; palpi and antennae fulvous. Thorax fulvous, variegated with fuscous above. Legs pale fulvous, front femur with a brownish band distally, front and middle tibia marked with brownish band proximally as well as distally, and hindtibia marked with brown only distally. Abdomen fulvous.

Forewing 10 mm. in length; membrane very slightly tinged with pale brownish, covered with numerous fine and short brownish striae. Venation mostly brownish; outer gradates fuscous black and narrowly margined with brown; middle gradates, first branch of radius beyond middle and first branch of Cu_1 also fuscous black and margined with brown; tiny round or oblong spots on these gradate crossveins; inner gradate crossveins wholly very pale. Costal area very narrow at base, but humeral crossvein recurrent with distinct branches; many

costal crossveins connected with each other transversely by small veinlets at level of their forks. Radius with four branches, apical branch forking twice before outer gradate; media forking at about the level of origin of first branch of radius; M_{3+4} coalescing with Cu_1 for a short distance; three series of gradate crossveins, 4 crossveins to inner, 5 to middle, and 10 to outer gradate series.

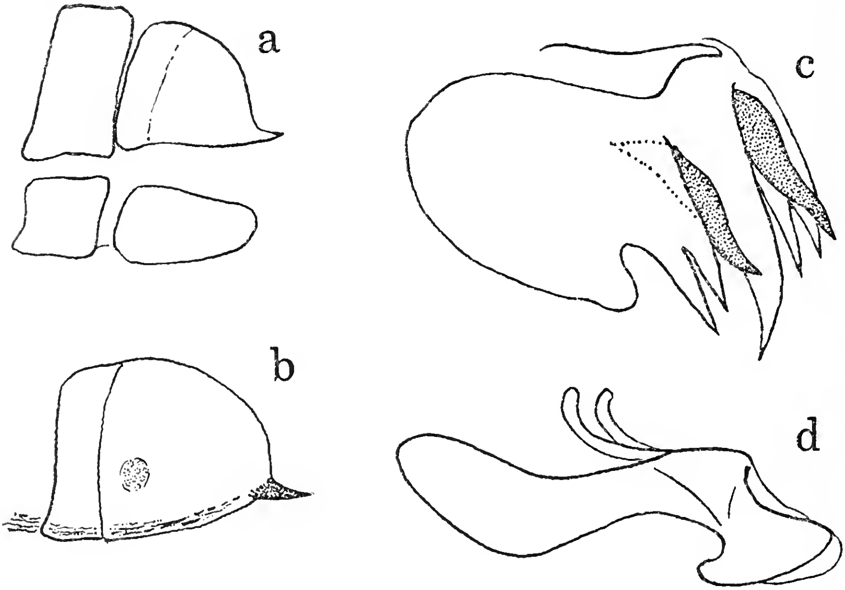
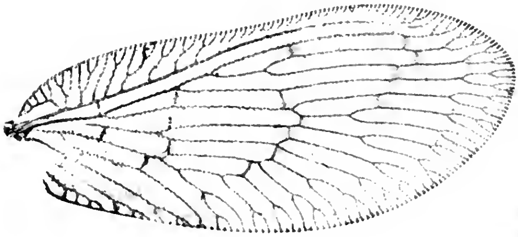


FIGURE 2.—*Nusalala krügeri*, new species (male genitalia): *a*, apex of abodmen, lateral view; *b*, anal plate, lateral view; *c*, 10th sternite, lateral and slightly dorsal view; *d*, parameres, lateral view.

Hindwing 8 mm. in length; membrane hyaline, narrowly tinged with fulvous in costal area, and narrowly grayish along outer and hindmargins; outer gradates almost black; inner gradates and adjacent portions of longitudinal veins fuscous; first branch of Cu_1 most conspicuously fuscous. Five branches to radial sector, six crossveins to inner, and nine to outer gradate series.

Male genitalia: Anal plate subtriangular in lateral view with ventrodistal angle produced into an acute spinous projection; projection arising from apodeme along the lower margins of anal plate and ninth tergite and extending basally into eighth segment. Ninth sternite, forming subgenital plate below anal plate, with rounded distal margin. Tenth sternite with large, oblong lateral "wings," each produced into a short roundish lobe at ventrodistal angle; middorsal part of bridge between "wings" raised into a prominence, and from below this dorsal prominence arises single long, tapering aedeagus with an acute apex; three pointed processes of about equal length on



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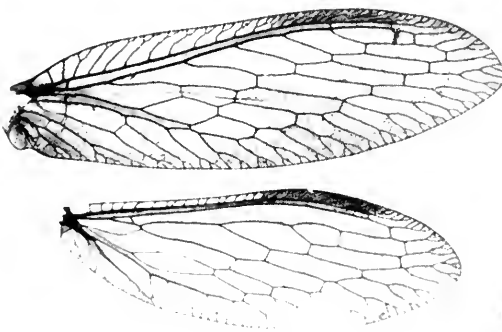

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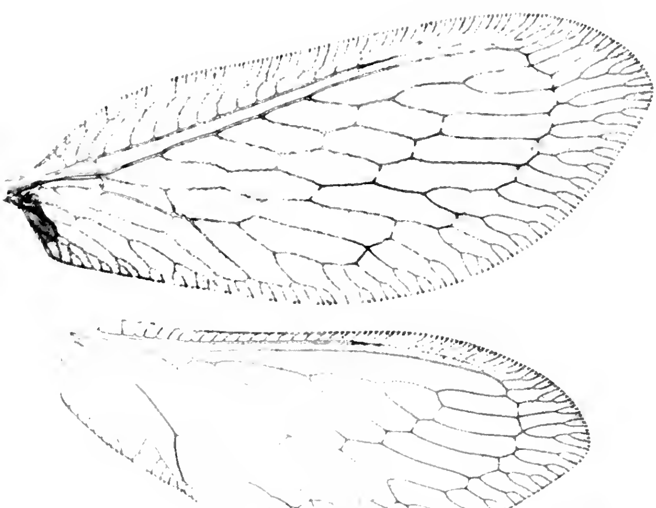
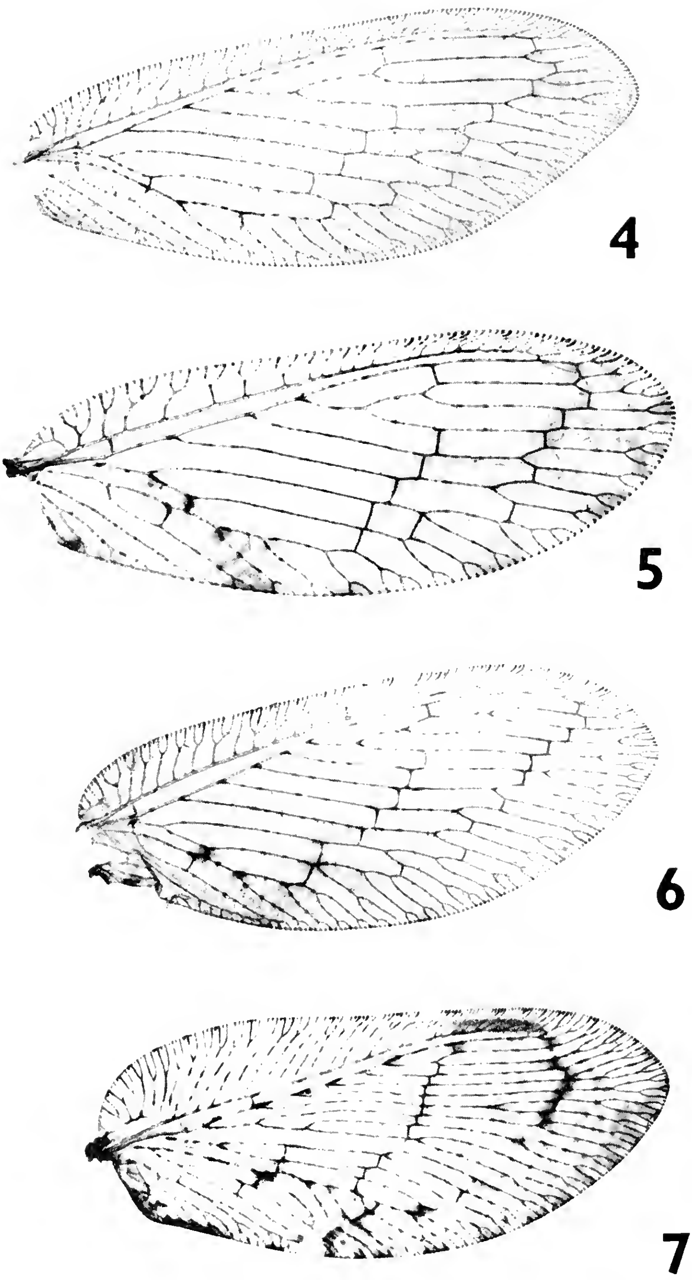


3

FIGURES 1–3.—1, *Sympherobius maculipennis* Kimmins, forewing; 2, *Pseudomicromus fuscatus*, new species, fore- and hindwings; 3, *Nusalala krügeri*, new species, fore- and hindwings.



FIGURES 4–7.—4, Forewings: *Hemerobius tolimensis* Banks; 5, *Hemerobius chilensis*, new species; 6, *Hemerobius exceptatus*, new species; 7, *Spinomegalomus flinti*, new genus and new species.

each side of aedeagus, all slightly shorter than aedeagus, parameres fused, bladelike for their basal two-thirds, apically forming a pair of oblong lobes; a pair of long, slender processes arises from about point of separation of parameres on dorsal side, directed proximally and then dorsally.

This new species can be recognized at once by the costal crossveins in forewing being very regularly crossed transversally by small veinlets. It represents, in all probability, Krüger's genus *Palaeomicromus* (Stettin Ent. Zeit., vol. 83, p. 170, 1922) based on "H (!) *schmidti* n. sp." from South America, which has never been described. The genitalic characters, however, are absolutely those of the genus *Nusalala*.

Genus *Hemerobius* Linnaeus

Hemerobius blanchardi Nakahara

Megalomus pallidus Blanchard, *in* Gay, Hist. Chile, Zool., vol 6, p. 126, 1851.
Schneiderobius pallidus.—Krüger, Stettin Ent. Zeit., vol. 83, p. 171, 1922.
Hemerobius pallidus.—Navás, Mem. R. Soc. Espan. Hist. Nat., vol. 16, p. 319, 1929. [Preoccupied by *Hemerobius pallidus* Stephens (1836).]
Hemerobius blanchardi Nakahara, Mushi, vol 34, p. 48, fig. 102, pl. 12 (fig. 24), 1960.

There are over 70 specimens, some in alcohol, from various localities in Peru, Brazil, Uruguay, Chile, and Argentina as follows: 47 specimens, Cañete, Peru, May and June 1941, "from cage with cotton buds," and 6 specimens from the same locality, Mar. 2, 1943, "predaceous on corn Aphis" (E. J. Hambleton); 1 specimen, Piura, Peru, September 1941 (P. A. Berry); 1 specimen, Pelotas, Brazil, November 1955 (C. Biezanko); 2 ♂, Montevideo, Uruguay, Nov. 23, 1954 (C. Biezanko); 2 specimens, Concepción, Chile, October 1927 (Jaffuel and Pirion) and Oct. 28, 1958 (Crampas); 4 specimens, Santiago, Chile, Dec. 2, 1940, "with mealy bugs" (G. O. Faure); 7 specimens, Puerto Varas, Llanquihue Prov., Chile, Mar. 5, 1959 (J. F. G. Clarke); 1 specimen, Salta, Argentina, May 12, 1927 (M. Kislink); 1 specimen, Catamarca, Argentina, June 2, 1927 (M. Kislink); 1 specimen, Correntoso, Río Negro, Argentina, November 1926 (R. and E. Shannon).

This is by far the most common Neotropical hemerobiid and the most widely distributed. The genitalic characters were fully described by Nakahara (loc. cit.).

Hemerobius tolimensis Banks

FIGURES 3*a–c*; PLATE 2 (FIG. 4)

Hemerobius tolimensis Banks, Proc. Ent. Soc. Washington, vol. 12, p. 158, 1910.

One ♂ and 2 ♀, Real del Monte, Hidalgo, Mexico (W. B. Kearfott); 1 ♂ and ♀, pine forest 7 miles south of Manzamitla, Mexico (H.

B. Leach); 1 ♀, Mexico City (R. Muller); 1 ♀, 10 miles south of Jalapa, Mexico (G. E. Bohart); 1 ♀, Real de Arriba, Temescaltepec, Mexico (H. E. Hinton and R. L. Ussinger); 1 ♀, Irazú, Costa Rica, 2300–2500 m., May 21–28, 1930 (Reimoser); 3 ♀, one bearing Banks' label "*Hemerobius tolimensis*," Irazú, Costa Rica (Schild-Burgdolf collection); 1 ♀, Chicó, Cundinamarca, Colombia, 2800 m., Jan. 24, 1959 (J. F. G. Clarke); 1 ♀, Barranquilla, Colombia, Mar. 20, 1952, labeled by Parfin as near *Hemerobius tibialis* Navás or *H. tolimensis* Banks (J. H. Hughes); 1 ♀, Valle Medellín, Colombia, September 1945 (F. Gallego); 1 ♀, Volcan, Sta. Maria, Guatemala (Schaus and Barnes).

This species is close to *Hemerobius pacificus* Banks, from which it can be distinguished by the somewhat narrower forewing with an "almost acute" apex. The male genitalia are also very much like those of *pacificus*, differing conspicuously by the presence of a rather large spiny process slightly anterior to apex of the upper arm of the bifurcate anal plate. This process is directed inward and only slightly upward so that often it is not seen in a lateral view of the anal plate. The shape of the anal plate is otherwise like that in *pacificus*. The processes of the aedeagus are also of the same type. The dilated part of each paramere is produced into a long, curved projection.

Hemerobius chilensis, new species

FIGURES 3*d–f*; PLATE 2 (FIG. 5)

Holotype ♂ and allotopotype ♀, in alcohol, 5 km. NW. of Punta Arenas, Chile, 200 m., Feb. 26, 1959 (J. F. G. Clarke); paratopotypes, 2 ♀, in alcohol, Mar. 3, 1959 (J. F. G. Clarke); paratypes, 1 ♀ in alcohol, Magallanes, Rio Tres Pasos, Chile, Dec. 11, 1961 (T. Cekalovic), 1 ♀, pinned, Magallanes, Rio Chabunco, Chile, Feb. 18, 1956 (T. Cekalovic), labeled "*Hemerobius sp.* nr. *pallidulus* Kimmins" by S. Parfin, USNM type 66868.

Head fulvous yellow; cheek brownish; palpi fulvous yellow; antennae paler yellow. Pronotum with yellow median band, broadly brown on sides; meso- and metanotum more broadly yellowish in middle, variegated with dark brown on sides. Legs pale. Abdomen brownish.

Forewing 6.5 mm. in length, elongate oval, apex rounded; membrane hyaline with very distinct markings: two brown fasciae over gradates, one over outer gradates intersected by a broad brown zone occupying space between first and second branches of radial sector external to inner gradates and extending to wing margin. Some distinct maculations in apical and hindmarginal areas; a very dark spot over each of following: crossvein m-cu, first fork of M, first fork of Cu_1, and over the cubital crossvein. Venation sparsely spotted with brown. Three branches to radius; basal crossvein between R and M at very origin

of latter and exceedingly short; crossvein m-cu not very short; second cubital cell not closed; five crossveins to inner and seven to outer gradate series. Hindwing hyaline, unmarked except for a pale brownish shading at marginal cubitoanal area and in pterostigmatic region. First branch of radial sector arising directly from R_1, separate from the remaining two branches, giving the appearance of two radial sectors.

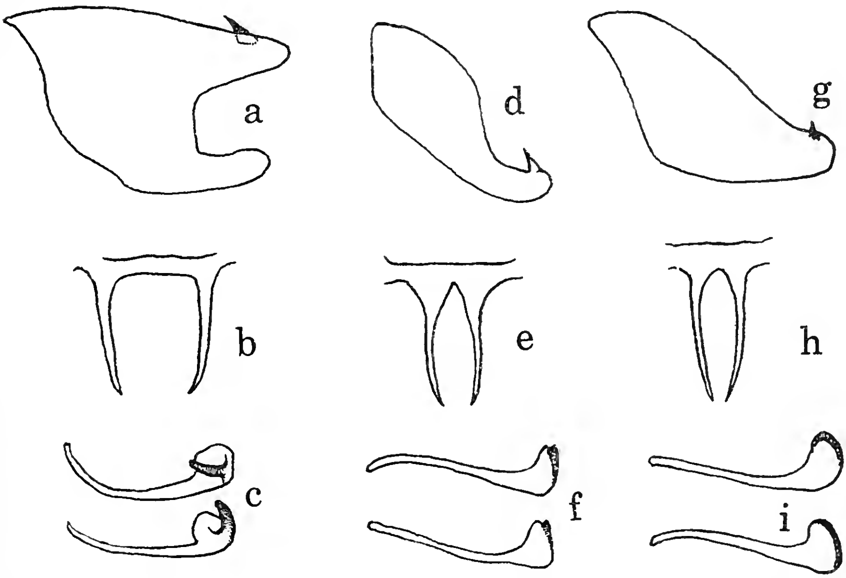


FIGURE 3.—Male genitalia: *Hemerobius tolimensis* Banks (*a–c*); *Hemerobius chilensis*, new species (*d–f*); *Hemerobius exceptatus*, new species (*g–i*). Anal plate, lateral view (*a, d, g*); processes of aedeagus, dorsal view (*b, e, h*); parameres (*c, f, i*).

Male genitalia: Anal plate narrow, especially so in its distal one-third; apex obtusely rounded and provided with an acute spiny process directed inward and upward. Tenth sternite of the usual form; processes of aedeagus long, slender, and very close together at their broadened bases. Apical dilatations of parameres roundish in outline, with narrow, raised ridge along the external margin.

Hemerobius exceptatus, new species

FIGURES 3*g-i*; PLATE 2 (FIG. 6)

Holotype ♂, Cundinamarca near Guasca, Colombia, 3500 m., Jan. 3, 1959 (J. F. G. Clarke); right wings (dry) and dissected parts of genitalia (in balsam) mounted on two slides, USNM type 66869.

Head fulvous yellow with fuscous brown gena; palpi brownish; basal joint of antennae yellowish (the rest of antennae missing).

Pronotum fulvous yellow, narrowly reddish brown on sides; reddish-brown bands broader on mesonotum, and extending onto metanotum, leaving a narrow yellowish line in middle; legs testaceous yellow, distal end of hindtibia and femur slightly marked with brownish. Abdomen brownish.

Forewing 9.5 mm. in length, 4 mm. in width; membrane faintly tinged with gray; venation largely testaceous and dotted with brown; both inner and outer gradates fuscous black, slightly margined with grayish; a conspicuous fuscous black spot over crossvein m-cu, and a smaller one over first fork of Cu_1; a series of six small black spots on radius at origin of M and of each branch of radial sector. Five branches to radial sector, the last forked three times proximal to outer gradates. First crossvein r-m vestigially short, just behind the basal subcostal crossvein; M forked slightly before origin of first branch of radial sector; Cu forked far out beyond the crossvein m-cu; 7 crossveins to inner and 10 to outer gradate series.

Hindwing 9 mm. in length; membrane hyaline; veins mostly pale, only four apical crossveins of outer gradate series, two discal crossveins, and first branch of Cu_1 distinctly fuscous black.

Male genitalia: Anal plate elongate, narrowed toward obtusely rounded apex provided with a small spiny process arising from dorsointernal margin and directed dorsointernally. Tenth sternite relatively small with slightly expanded lateral "wing"; processes of aedeagus very long, somewhat longer than parameres, directed posteriorly and then strongly downward, and situated rather close together; each aedeagal process very fine and almost uniformly slender for the whole length. Parameres roundly dilated distally, each with a heavily sclerotized apical border.

This is an exceptional species on account of the great development of the radial sector: not only are there five, instead of the usual three, branches arising from radius, but the last branch is forked three times before the outer gradates. This indicates that the increased number of branches is real, not due to mere proximal displacement of the branches usually present.

Spinomegalomus, new genus

A peculiarity of this genus consists in the prolongation of the seventh abdominal tergite in the male into a long dorsal process. Genitalically, the anal plate is very long and narrow, contrasted to the subtriangular form in *Megalomus*. In finer morphology of the male genitalia, this genus differs from *Megalomus* by the epimeres being fused onto the dorsolateral margin of the wings of the tenth sternite, absence of phallobase, presence of hypomeres, and completely fused parameres of peculiar structure.

Type species: *Spinomegalomus flinti*, new species.

This genus cannot be clearly separated from *Megalomus* in venational characters. There are a few crossveins connecting the branches of the radial sectors in the forewing near their bases. These basal-radial crossveins may be of phylogenic significance.

Spinomegalomus flinti, new species

FIGURE 4; PLATE 2 (FIG. 7)

Holotype ♂, Magallanes, Punta Arenas, Chile, ex *Berberis buxifolia*, Nov. 21, 1961 (T. Cekalovic) in alcohol. Right wings (dry) and dissected parts of genitalia (in balsam) mounted on two slides, USNM type 66870.

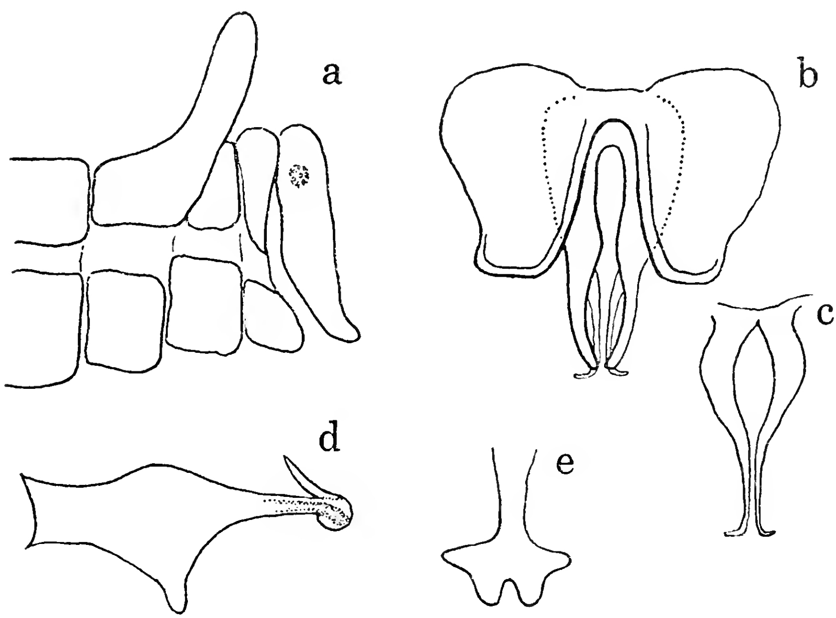


FIGURE 4.—*Spinomegalomus flinti*, new genus and species (male genitalia): *a*, apex of abdomen, lateral view; *b*, 10th sternite, dorsal view; *c*, inferior processes (hypomeres) of 10th sternite, ventral view; *d*, parameres, lateral view; *e*, apex of parameres, dorsal view.

Face fuscous, almost black, paler on sides below the eyes; vertex fuscous black in middle; palpi and antennae fuscous. Pro- and mesonotum fuscous black with three irregular and broken longitudinal pale stripes, median one very narrow and two lateral ones broader; mesoscutellum pale; metanotum fuscous, paler in middle, with two black spots on metascutum. Legs pale, except tibia of foreleg, which is marked with fuscous in front along basal one-third and near distal end. Abdomen marmorated with fuscous brown dorsally; middorsal part of seventh

tergite produced into a long process with obtuse end, directed dorsally, almost at right angles to the axis of the body.

Forewing 8.5 mm. in length; costal area very broad, most abruptly broadened at base; apex narrowly rounded. Membrane hyaline with partially confluent pale gray maculations and alternate blackish and whitish short streaks along margin; blackish streak over several apical crossveins of outer gradate series; lighter colored streaks over anterior half of inner gradate series; bases of radial branches marked with blackish spots; a black spot over outermost crossvein m–cu; another black mark over first fork of Cu_1 and the crossvein just behind it. A narrow hyaline-white area from hindmargin inward at cubitoanal junction, bordered with a blackish streak on outer side. Venation pale, whitish, spotted and streaked with blackish at sites corresponding to the maculations of membrane. Six branches to radius, first branch forked twice before inner gradates; two subcostal crossveins before stigmatic area; three crossveins between radial branches near their bases; media dichotomously forked twice before inner gradates; Cu_1 with five branches before outer gradates; Cu_2 forked near base. Basal gradate series of 5 crossveins, inner gradate series of 12 crossveins between radius and cubitus; outer gradates of 16 crossveins reaching Cu_1; a series of 6 crossveins from Cu_1 to hindmargin of the wing.

Hindwing membrane hyaline, tinged with gray in area behind cubital fork and about apex of wing; a few dark dots on apical margin; several apical crossveins of outer gradate series marked with gray. Venation mostly pale but darkened in areas where membrane is grayish; pterostigmatic area dark. Five branches to radius; discal (inner) gradates of three crossveins; outer gradates of nine crossveins.

Male genitalia: Anal plate very narrow, with no spinous projection, produced into an oblong apical, posteriorly bent lobe. Ninth sternite short, posterior margin not reaching apex of anal plate. Tenth sternite produced into large dorsolateral wings, with very short bridge of gonarcus arch between (which imposes on the "wings" far more dorsal positions than usual for the family); epimeres fused into dorsal border of "wings"; aedeagus paired, each lobe very slender, fused at base without showing recognizable phallobase; a pair of long and slender processes below aedeagus, superposed by processes of the latter. (These hypoaedeagal processes may be termed hypomeres.) Parameres fused, presenting a long subquadrate shape in dorsal view, produced sharply at corners and with distal prolongation ending in an apically bipartite head with lateral lobes. In lateral view, the lateroanterior angle appears as an obtuse ventral prolongation, and the distal "head" presents the shape of a large pointed process which is recurved over the narrow neck.

The morphology of male genitalia in this species is totally unlike that of *Megalomus;* the narrow anal plate, epimeres fused with dorso-lateral border of "wings" of 10th sternite, the absence of differentiated phallobase, the presence of "hypomeres," and completely fused parameres of extraordinary structure, all point to the fundamental dissimilarity of *Spinomegalomus* and *Megalomus*.

Genus *Megalomus* Rambur

Megalomus minor Banks

FIGURE 5

Megalomus minor Banks, Trans. Amer. Ent. Soc., vol. 32, p. 43, 1905.—Carpenter, Proc. Amer. Acad. Arts Sci., vol. 74, p. 242, fig. 44, 1940.

One ♂, Ft. Gulick, Canal Zone, Panama, Aug. 21, 1952, and 2 ♀, Cabeja, Panama, Sept. 16, 1952 (F. S. Blanton), in alcohol. In addition, there are 15 pinned specimens (mostly females but the sexes of some cannot be determined because of the lack of abdomens) from the following localities: 10 miles north of Tamazunchale, San Luis Potosí, Mexico, Dec. 24, 1940 (G. E. Bohart); 10 miles south of Jalapa, Mexico, Dec. 28, 1940 (G. E. Bohart); Cuernavaca, Mexico, April 1945 (N. L. H. Krauss); Quinta Chilla, Tamazunchale, Mexico,

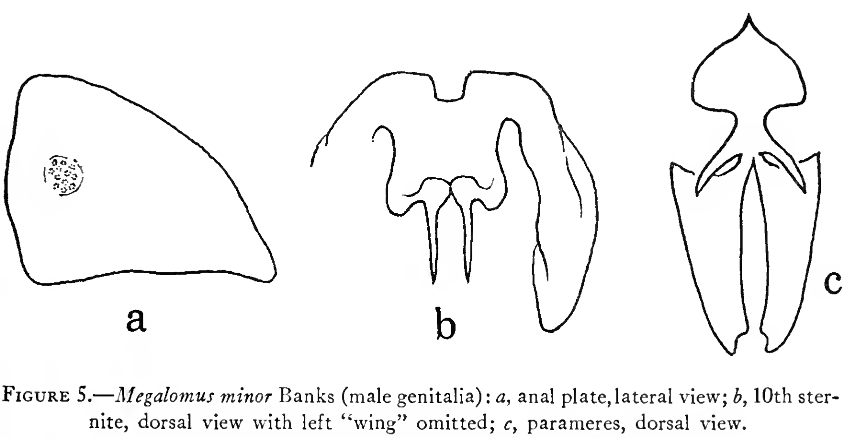


FIGURE 5.—*Megalomus minor* Banks (male genitalia): *a*, anal plate, lateral view; *b*, 10th sternite, dorsal view with left "wing" omitted; *c*, parameres, dorsal view.

Dec. 20, 1948 (E. S. Ross); Fortín, Veracruz, Mexico, Aug. 12, 1954 (Insp. Lewis, at Laredo, Tex., on orchids); Lion Hill, Canal Zone, Panama, June 18, 1907 (August Busck), bearing Banks' label "*Megalomus minor* Banks"; Tabernilla, Canal Zone, Panama, June 20, 1907 (August Busck); La Campana, Panama, Sept. 12, 1952 (F. S. Blanton); Chiriquí, Panama, Dec. 16, 1952 (F. S. Blanton); Honduras, October 1935; Guatemala, December 1934; San Salvador, El Salvador (P. A. Perry), bearing Parfin's label "*Megalomus* nr. *minor*"; Colombia,

May 1935; Valle Medellín, Colombia, September 1945 (M. Gallego). There is also a single female from Pôrto Bello, Brazil, collected by Busck, which is difficult to separate from this species.

Forewing 4.5–5 mm. in length, well rounded apically, with five branches to radius; inner gradates, usually consisting of seven cross-veins, very straight, narrowly margined with brown with a narrow hyaline zone external to it. This hyaline zone is not mentioned by Carpenter, but otherwise his description of the type of *M. minor* agrees.

The genitalia of the male in the above lot were dissected and found to be structurally compatible with the description and figures given by Carpenter. Anal plate subtriangular in lateral view; 10th sternite with broad lateral "wings"; aedeagus in the form of a pair of long, slender processes, arising from subquadrate phallobase; parameres fused anteriorly into a somewhat subtriangular basal piece, and separated posteriorly into two large arms, each ending in a short, pointed process. A pair of the characteristic toothlike projections present between base and arms of parameres.

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HERMATOBATES, A NEW GENERIC RECORD FOR THE ATLANTIC OCEAN, WITH DESCRIPTIONS OF NEW SPECIES (HEMIPTERA: GERRIDAE)

By Jon L. Herring [1]

The genus *Hermatobates* is certainly the rarest and least known genus of marine Hemiptera. It was founded by Carpenter in 1892 for the reception of a new species, *H. haddoni*, based on a single specimen from Mabuiag Island in the Torres Straits, northern Australia. Since that time, five other species have been described. The descriptions of the six species were based on a total of nine specimens and several of the species are still known only from the type material. Females for the most part are either unknown or unassociated with the males. In 2½ years of entomological work in the South Pacific, I was able to collect only three specimens; so it is not surprising that very few museums have representatives of this remarkable genus.

The genus has a widespread distribution. One species, *haddoni*, the best known of the group, occurs from New Caledonia in the East to Australia, the Philippines, and the Ryukyus in the West. Two species, *weddi* China and *walkeri* China, are known from the Australian region: Monte Bello Island and the Arafura Sea, respectively. *H. marchei* (Coutiere and Martin) is known from the Philippines only,

[1] Entomology Research Division, Agricultural Research Service, U.S. Department of Agriculture.

djiboutensis Coutiere and Martin occurs in the Red Sea (Gulf of Aden), and *hawaiiensis* China is known from Oahu, Hawaii. The new species described below from Dominica Island, British West Indies, represents the first record of this genus from the Atlantic Ocean. A second new species from Central Polynesia (Tuamoto Archipelago) is also described.

Esaki (1947) has given an interesting account of the habits of *H. haddoni*. It inhabits coral reefs and at low tide skates about on the surface of tidal pools and in the small pools of water contained in dead *Tridacna* mollusk shells, where it apparently feeds on Collembola, marine midges, and perhaps on water striders of the genus *Halovelia*. As the tide comes in, *Hermatobates* conceal themselves in the crevices of the coral, underneath blocks of loose coral, or in dead *Tridacna* shells so that at high tide these water striders may be submerged under 10 feet or more of water.

In addition to the type material described below, I am depositing my collection of *Hermatobates* (15 specimens, mostly females and nymphs) in the U.S. National Museum.

I take great pleasure in naming the following new species for Mr. Bruce Bredin, who sponsored the Smithsonian-Bredin Expeditions to the West Indies in 1956 and 1958.

Hermatobates bredini, new species

Figure 1

A small brown species with antennal segments in proportion 12:13:8:11. Anterior trochanter, femur, and tibia without teeth or spurs. Posterior margin of metasternum straight without median prominences, armed only with minute teeth.

Holotype male. Head viewed from above transverse, width across eye level four times greatest length; triangular; antenniferous tubercles not prominent nor visible from above; eyes small, with short erect bristles, ocular width about one-quarter that of vertex between eyes (4:17), this distance twice as great as length of head seen from above (17:7); covered with pale pubescence and longer tufts on apex and sides; frontal suture running close to base of head, sinuate, extending forward laterally, area between it and eyes flattened; clypeus prominent between antenniferous tubercles. Antenna densely covered with fine pubescence, relative lengths of segments 12:13:8:11. Rostrum extending a little beyond the bases of the anterior trochanters, relative lengths of segments 6:2:5:4.

Pronotum very short, little more than half the width of an eye, widening behind eyes, pubescence dense and fine. Fused meso- and metanotum and abdominal segments dull with short pubescence on

disc becoming longer laterally and posteriorly. Suture between meso- and metasternum distinct; posterior margin of metasternum gently rounded with very fine, indistinct black teeth at middle.

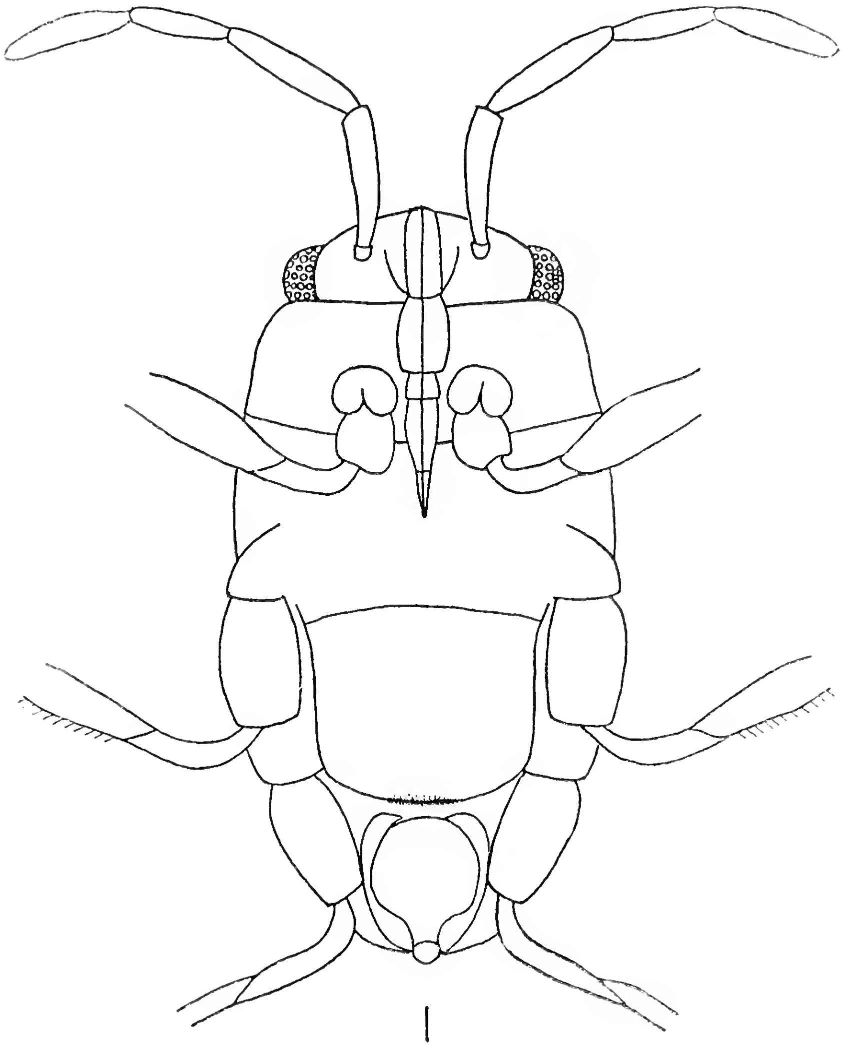
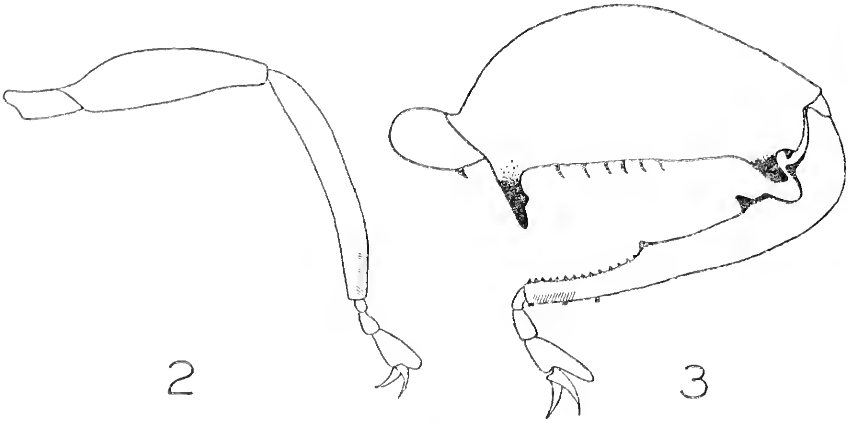


FIGURE 1.—*Hermatobates bredini*, new species: ventral view.

Anterior trochanter unarmed; anterior femur (fig. 2) only moderately incrassate, without teeth or tubercles of any kind, anterior tibia unarmed but with the usual oblique combs of spines at apex. Middle and hindfemur feebly incrassate, middle femur with row of approximately 20 black spines and a few long bristles; middle and hindtrochanter unarmed; hindfemur unarmed. Measurements (27.5

units=1 mm.): anterior femur 21, anterior tibia 25, anterior tarsus 1:2:4; middle femur 32, middle tibia 20, middle tarsus 2:13:10; hindfemur 32, hindtibia 21, hindtarsus 2:11:10.

Styliform processes of 8th abdominal segment prominent, their apices spoon shaped and covered with long hairs; genital capsule hemispherical, prominent.



FIGURES 2, 3.—Anterior femur: 2, *Hermatobates bredini*, new species; 3, *Hermatobates tiarae*, new species.

Total length, holotype male, 2.5 mm.; greatest width 1.2 mm.

Female unknown.

Type locality: Woodbridge Bay, Dominica, British West Indies, collected at light. Holotype (USNM 66875) collected by W. L. Schmitt, Mar. 25, 1956.

Diagnosis: This species resembles *H. hawaiiensis* China in that the forefemur and tibia are unarmed, but it differs in lacking a tooth on the anterior trochanter, in having the prosternum with rounded margin rather than a pair of prominences, and in having distinctive spoon-shaped styliform processes. *H. bredini* differs from all other species of the genus by the unarmed forefemur and tibia.

Hermatobates tiarae, new species

FIGURE 4

A medium-sized, dark-brown species with antennal segments I and II in proportion 19:23 (III and IV missing in unique male). Anterior trochanter with a single spine; femur very strongly swollen, armed with spines and teeth; tibia armed. Posterior margin of metasternum faintly but distinctly bilobed, armed only with minute black teeth.

Holotype male. Head viewed from above transverse, four times wider across eyes than long in middle, triangular; antenniferous

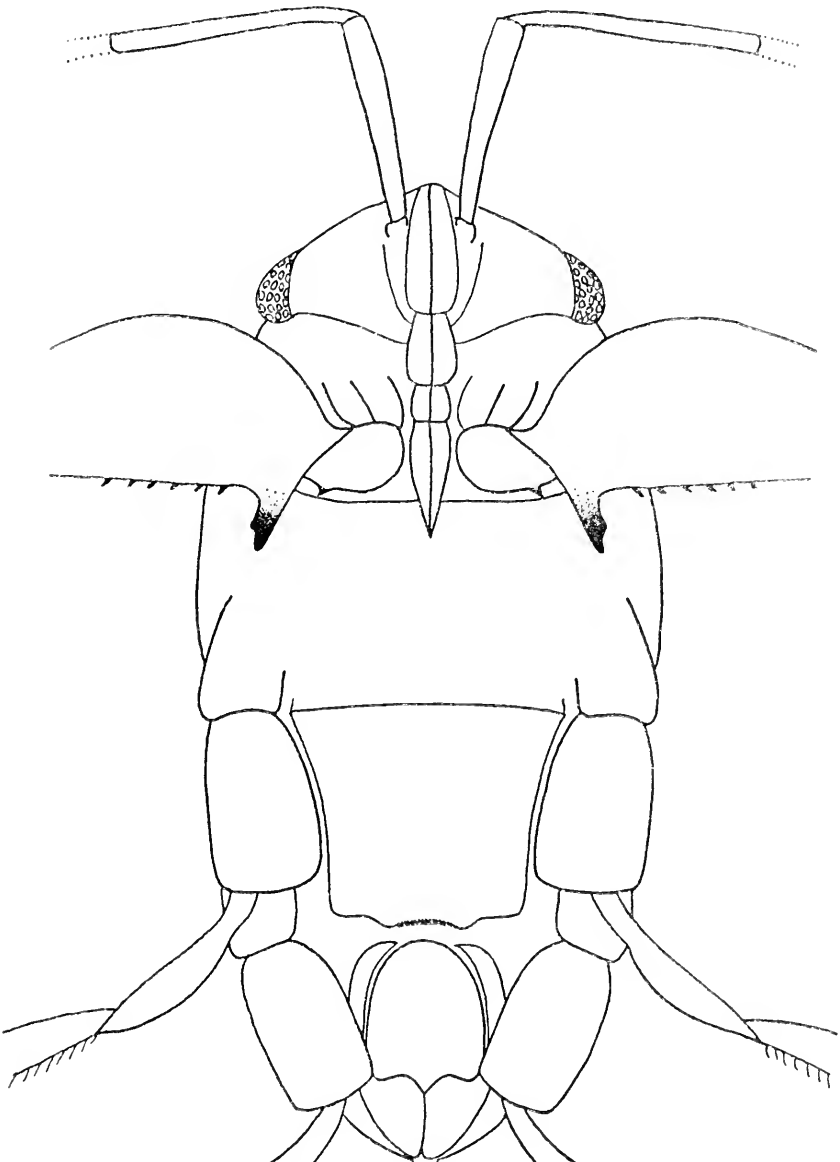


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FIGURE 4.—*Hermatobates tiarae*, new species: ventral view.

tubercles prominent but not visible from above; eyes small, with short erect bristles, ocular width about one-quarter that of vertex between eyes (6:23), this distance two and one-half times as great as length of head seen from above (23:9), head covered with pale pubescence and longer tufts on apex and sides; frontal suture running very close to base of head, sinuate, extending forward laterally, area between it and eyes gently sloping, not distinctly flattened; clypeus prominent between antenniferous tubercles. Antenna densely covered with erect silvery hairs that are denser and longer on the first segment than on second, relative lengths of segments 19:23:-:-. Rostrum extending a little beyond the anterior trochanters, relative lengths of segments 10:3:9:6.

Pronotum very short, little more than half the width of an eye, widening behind eyes, pubescence dense and fine. Fused meso- and metanotum and abdominal segments covered with very dense white pubescence becoming longer laterally and posteriorly. Suture between meso- and metasternum distinct, posterior margin of metasternum (fig. 4) faintly but distinctly bilobed at middle with fine black teeth between the lobes.

Anterior trochanter armed with a tooth near apex; anterior femur (fig. 3) strongly incrassate, slightly over twice as long as greatest width; its underside covered with long hairs, armed with a strong, very prominent long spine at base, directed posterolaterally, a blunt black tooth near apex followed by a small inwardly directed tooth; a row of six short, curved spines between the basal and apical spines; anterior tibia covered with long hairs that are erect on outer side and directed towards apex of tibia on inner side, base of tibia with a black thickening ending in a tooth, followed by a deep depression for the reception of the large tooth on apex of femur, beyond depression, a second thickening ending in a tooth, and a third tooth near apical third, followed by a row of small black triangular teeth that extend to apex; outer side of tibia with three fairly evenly spaced black pegs on apex, the usual pair of oblique combs of bristles present on apex. Middle femur distinctly thickened on basal third, densely covered with long hairs, some of these as long as the width of the segment at the point where they arise, a row of approximately 20 distinct hooked spines on under side; tibia and tarsus laterally compressed, covered with long, white hairs, tarsus three segmented; hindfemur unarmed, slightly thickened in middle, covered with long hairs; hindtibia and tarsus laterally compressed, covered with long hairs. Measurements (27.5 units=1 mm.): anterior femur 42, anterior tibia 40, anterior tarsus 2:4:11; middle femur 48, middle tibia 28, middle tarsus 3:14:15; hindfemur 48, hindtibia 28, hindtarsus 3:13:15.

Styliform processes of the 8th abdominal segment prominent, rather slender, acute at apices, covered with long hairs, dorsal lobes of 8th segment enlarged and conspicuous, covered with dense pubescence; genital capsule large.

Total length, holotype male, 3.45 mm., greatest width 1.60 mm.

Female unknown.

Type locality: 14°56′ S., 146°1′ W. (Tuamotu Archipelago, French Oceania) collected at light by Martin W. Johnson, Jan. 21, 1953. Holotype (USNM 66876).

Diagnosis: This species superficially resembles *djiboutensis* C. and M. but differs from all known species of *Hermatobates* by the structure of the anterior femur and tibia. No other known species has such a large spine on the base of the femur or the socket at the base of the tibia for the reception of the apical spine of the femur. In addition, the head is four or more times as wide across eyes as length of head along midline, and the sinuate margin of the metasternum bears very small black spines or minute tubercles.

China and Usinger (1950) recorded *H. haddoni* from the Marquesas, on the basis of a single immature specimen collected by Miss Evelyn Cheesman at Tahuata. It seems unlikely that this record refers to *H. haddoni* since there are now two distinct species known in Central Polynesia, and there is no other record of *H. haddoni* from east of New Caledonia.

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BENTHIC POLYCHAETOUS ANNELIDS FROM BERING, CHUKCHI, AND BEAUFORT SEAS[1]

By Donald J. Reish[2]

Introduction

The earlier accounts on the study of the polychaetous annelids in Alaskan waters have been summarized by Hartman (1948). Since this date, several papers dealing with the polychaetes of Alaska or adjoining regions have appeared. Pettibone (1954) recorded 88 species from Point Barrow, Alaska. The monograph by Uschakov (1955) of the polychaetes of the Far Eastern seas is of particular value for work in Alaskan waters. The series of papers by Berkeley and Berkeley (1956, 1957, 1958, and 1960) have records of species for Alaska as well as British Columbia. Pelagic and benthic polychaetes collected from floating ice islands in the Arctic Ocean have been reported by Uschakov (1957) and Knox (1959). Levenstein (1960) listed 48 species from the western Bering Sea, 19 of which are reported herein. Seven species of polychaetes were found in a marine pond at Point Barrow, Alaska (Mohr et al, 1961).

[1] These studies were aided in part by contracts between the Office of Naval Research, Department of the Navy, and the University of Southern California; and between Dr. John L. Mohr, University of Southern California, and the Arctic Institute of North America.

[2] Department of Biology, Long Beach State College, Long Beach, California.

Since the offshore waters of Alaska have been investigated to a limited extent, quantitative collections made by John Tibbs in the Bering and Chukchi Seas have been particularly rewarding. Smaller collections made by R. Lavenberg from a floating ice island in Chukchi and Beaufort Seas and by the author in Beaufort Sea have been included in this report.

I am indebted to many people and organizations for their assistance during the course of this study (see footnote 1). I wish to express thanks to John Tibbs and R. Lavenberg for making most of these collections. Particular thanks are due the U.S. Coast Guard for permitting me to spend five days aboard the icebreaker U.S.S. *Northwind* in August 1953 to make bottom collections. I wish also to thank Dr. John L. Mohr, who introduced me to the Arctic biology and who made it possible to complete this study.

Materials and methods.—Collections from the Bering and Chukchi Seas (Stations 5–60) were made by John Tibbs, University of Southern California, from R/V *Hugh M. Smith* in the summer of 1960 (see table 1 and fig. 1). The majority of the samples were taken with a Dietz-Lafond snapper, but some samples were taken with a small Hayward orange-peel bucket and by aqualung diving. The collections for Stations A–F and G–1 to G–6 were made by R. Lavenberg, University of Southern California, in the spring of 1960 from the ice island Bravo utilizing a small orange-peel bucket (Stations G–1 to G–6) and a biological dredge (Stations A–F). Collections from the Beaufort Sea (Stations R–1 to R–4) were made by me in August 1953 from the U.S. Coast Guard icebreaker *Northwind*. Samples were taken with either a Dietz-Lafond snapper or a small Hayward orange-peel bucket.

The method of preservation varied according to conditions and the preservative available. Mr. Tibbs washed samples through fine screens to retain, as much as possible, the smaller organisms. Sediment analysis was done by the personnel at the U.S. Naval Electronic Laboratory in San Diego. Sediment terminology follows the size classification of Udden-Wentworth (Barnes, 1959).

All material on which this study is based, including holotypes and paratypes, has been deposited in the U.S. National Museum.

Figure 1.—Station locations: stations 5–60 collected by John Tibbs from R/V *Hugh M. Smith*, July, August 1960; stations A–F dredged by R. Lavenberg from ice island drift station Bravo, April, May 1960; station G, 6 bottom samples taken by R. Lavenberg from drift station Bravo, May–August 1960; station R, 4 bottom samples taken by author from U.S. Coast Guard icebreaker *Northwind* August 1953.

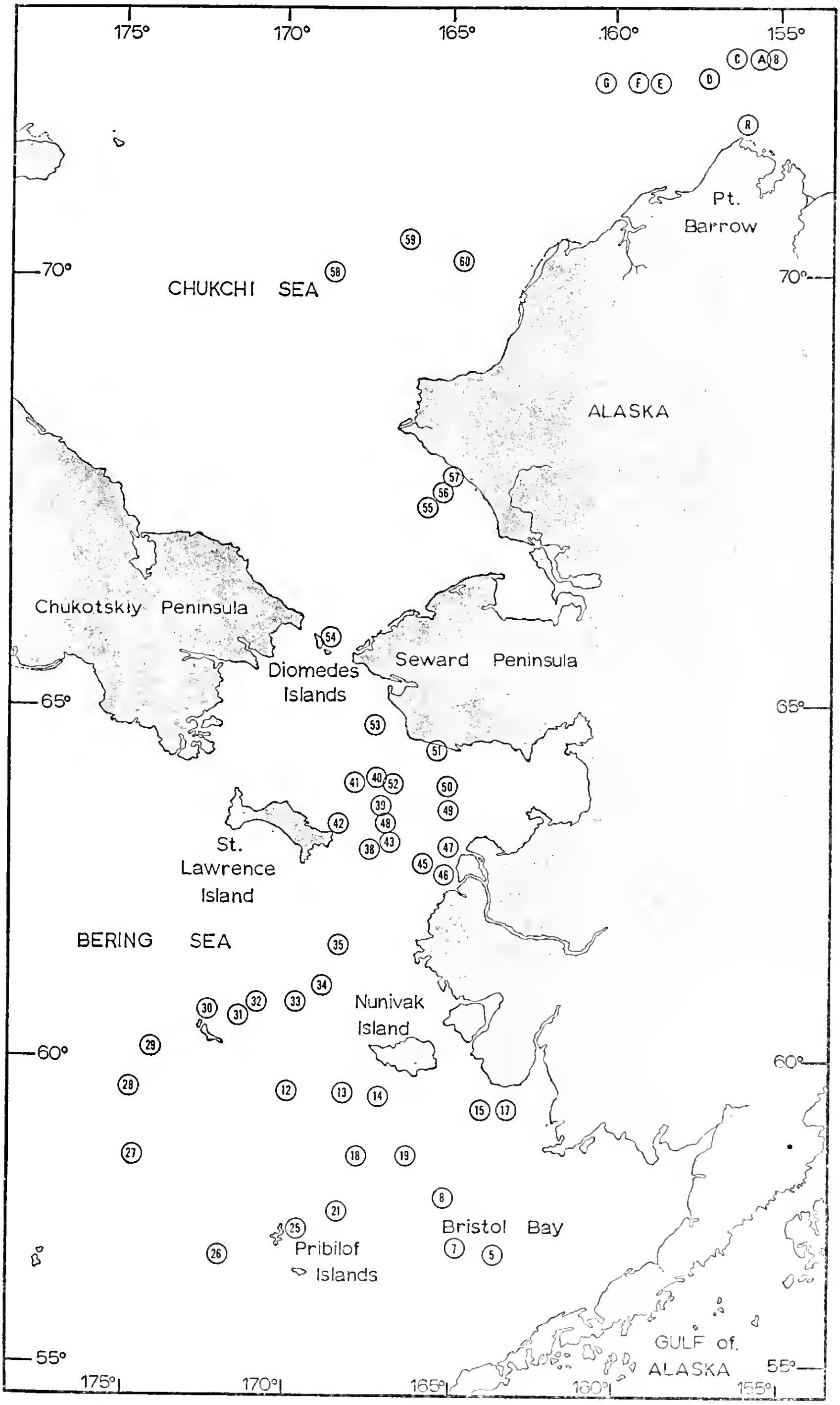
175°
170°
165°
160°
155°
70°
65°
60°
55°
CHUKCHI SEA
Pt. Barrow
ALASKA
Chukotskiy Peninsula
Diomedes Islands
Seward Peninsula
St. Lawrence Island
BERING SEA
Nunivak Island
Bristol Bay
Pribilof Islands
GULF of ALASKA

TABLE 1.—*Station locations*

Station number	Date	N Latitude	W Longitude	Depth (in meters)	Sediment type based on median diameters
5	7/12/60	56°54.0′	163°45.0′	67.1	silt
7	7/13/60	57°52.0′	165°12.0′	43.9	–
8	7/13/60	57°52.3′	165°11.0′	45.7	–
12	7/15/60	59°30.0′	170°00.0′	54.9	–
13	7/15/60	59°29.0′	168°24.0′	36.6	–
14	7/15/60	59°25.5′	167°13.5′	31.1	–
15	7/16/60	59°15.0′	164°04.0′	18.3	–
17	7/16/60	59°17.0′	163°28.0′	11.0	–
18	7/17/60	58°33.6′	165°57.0′	32.8	–
19	7/17/60	58°29.0′	166°22.0′	40.2	fine sand
21	7/18/60	57°39.0′	168°37.5′	67.7	silt
25	7/19/60	57°07.7′	170°18.7′	18.3	–
26	7/20/60	56°49.0′	172°24.0′	120.7	very fine sand
27	7/21/60	58°36.0′	174°56.0′	228.6	–
28	7/22/60	59°38.0′	175°04.0′	128.0	silt
29	7/22/60	60°13.5′	174°13.5′	91.4	silt
30	7/23/60	60°41.0′	172°27.0′	51.2	silt
31	7/23/60	60°45.5′	171°34.0′	58.5	silt
32	7/23/60	60°48.0′	171°00.0′	54.8	silt
33	7/24/60	60°55.0′	169°53.0′	43.9	silt
34	7/24/60	61°10.0′	168°52.0′	32.8	very fine sand
35	7/24/60	61°43.5′	168°31.0′	34.8	silt
38	7/25/60	63°07.8′	167°33.0′	32.8	fine sand
39	7/26/60	63°40.0′	167°13.0′	59.7	very fine sand
40	7/26/60	64°08.8′	167°22.5′	29.3	fine sand
41B	7/26/60	64°00.0′	168°00.0′	32.8	fine sand
42B	7/27/60	63°21.0′	168°46.0′	16.5	silt
43	7/27/60	63°08.0′	167°11.0′	36.6	fine sand
45	7/28/60	62°54.0′	165°00.0′	20.1	silt
46	7/28/60	62°45.0′	165°22.0′	12.8	silt
47	7/28/60	63°05.5′	165°12.0′	11.0	silt
48	7/28/60	63°22.5′	165°07.0′	12.2	silt
49	7/28/60	63°37.0′	165°15.0′	22.9	silt
50	7/28/60	63°52.4′	165°15.3′	–	–
51	7/29/60	64°28.2′	165°20.0′	9.1	silt
52	7/29/60	64°00.0′	167°00.0′	32.6	very fine sand
53	7/30/60	64°44.0′	167°22.0′	33.5	fine sand
54	7/30/60	65°36.7′	168°45.0′	0–22.9	–
55	7/31/60	67°26.5′	165°45.0′	36.6	silt
56	7/31/60	67°37.1′	165°19.0′	39.0	silt
57	7/31/60	67°43.3′	164°55.0′	27.4	silt
58	8/ 1/60	70°02.0′	168°44.0′	45.7	silt
59	8/ 2/60	70°21.0′	166°22.0′	42.6	silt

TABLE 1.—*Station locations*—Continued

Station number	Date	N Latitude	W Longitude	Depth (in meters)	Sediment type based on median diameters
60	8/ 2/60	70°07.5′	164°48.5′	45.9	very fine sand
A	4/ 8/60	70°10.0′	155°29.0′	289.9	–
B	4/ 9/60	70°10.0′	155°29.0′	143.8	–
C	4/10/60	70°07.0′	156°23.0′	145.1	–
D	4/17/60	70°47.8′	157°13.0′	64.0	–
E	5/ 1/60	71°49.0′	158°50.0′	57.1	–
F	5/ 4/60	71°54.0′	159°21.0′	50.9	–
G–1	5/14/60	71°51.0′	159°44.0′	50.0	–
G–2	5/26/60	71°53.0′	160°24.0′	42.4	–
G–3	6/24/60	71°53.0′	160°24.0′	42.1	–
G–4	6/30/60	71°53.0′	160°24.0′	42.1	–
G–5	7/31/60	71°51.0′	160°20.0′	39.0	–
G–6	8/15/60	71°51.0′	160°20.0′	38.1	–
R–1	8/ 8/53	71°24′30″	156°21′50″	9.8	–
R–2	8/10/53	71°26′45″	156°13′20″	12.8	–
R–3	8/11/53	71°26′15″	156°25′00″	12.8	–
R–4	8/11/53	71°35′00″	155°33′00″	96.3	–

DISCUSSION.—A total of 67 species, 2 of which are new, are reported herein from the Bering, Chukchi, and Beaufort Seas. The most numerous species in the collection are: *Pholoe minuta, Glycinde wireni, Haploscoloplos elongatus, Cossura longocirrata, Tharyx multifilis?, Sternaspis scutata, Heteromastus filiformis,* and *Myriochele heeri.* The latter was the most frequently encountered species; it was particularly common at some of the stations south and east of St. Lawrence Island (see fig. 1). Principal associates with this tube-building polychaete were *Pholoe minuta* and *Haploscoloplos elongatus,* with *Glycinde wireni* and *Tharyx multifilis?* present less frequently.

In addition to the 2 new species encountered, new distributional records were established for 12 species. The northern distribution was extended for 8 species, namely, *Arctonoe pulchra, Harmothoe hartmanae, Typosyllis alternata, Micronephthys minuta, Haploscoloplos elongatus, Spiophanes bombyx, Travisia brevis,* and *Rhodine bitorquata.* Four species are newly recorded from Alaskan waters: *Naineris quadricuspida, Skardaria fragmentata, Cossura longocirrata,* and *Ophelia borealis.*

Data on the geographical and depth distribution have been included for each species only when the information is new or not included in Pettibone (1954).

Family Polynoidae

Arctonoe pulchra (Johnson)

Polynoe pulchra Johnson, 1897, p. 177.
Arctonoe pulchra.—Pettibone, 1953, pp. 61–64, pl. 30, figs. 272–280.—Hartman, 1961, p. 7.—Imajima and Hartman, 1964, p. 19.

Material: Stations 42B(1), 54(1); Bering Sea; sandy silt. Pettibone (1953) lists the hosts from which *A. pulchra* has been taken; it is not known whether or not these specimens were free living or commensal.

Distribution: *Arctonoe pulchra* was known previously from Gulf of Alaska to Cedros Islands, Lower California, Japan, and Okhotsk Sea. The northern distribution is extended herein to the Diomede Islands.

Eunoe oerstedi Malmgren

Eunoe oerstedi Malmgren, 1865, p. 61, pl. 8, fig. 3.—Pettibone, 1954, pp. 219–220, fig. 26d.—Berkeley and Berkeley, 1956, p. 234.

Material: Stations 54(1), 57(1); Bering and Chukchi Seas; silty sand.

Gattyana cirrosa (Pallas)

Aphrodita cirrosa Pallas, 1766, p. 95, pl. 8, figs. 3–6.
Gattyana cirrosa.—Hartman, 1948, p. 14.—Pettibone, 1954, pp. 226–228, fig. 26b.—Berkeley and Berkeley, 1958, p. 803.

Material: Stations 54(1), G–6(1); Chukchi Sea.

Gattyana iphionelloides (Johnson)

Harmothoe iphionelloides Johnson, 1901, pp. 391–392, pl. 1, figs. 2–7.
Gattyana iphionelloides.—Pettibone, 1953, pp. 44–45, pl. 22, figs. 194–200.

Material: Stations 54(1); Little Diomede Island.

Harmothoe hartmanae Pettibone

Harmothoe hartmanae Pettibone, 1948, pp. 412–413, fig. 1; Pettibone, 1953, pp. 36–37, pl. 17, figs. 147–154.

Material: Stations 54(1); Little Diomede Island.

Remarks: This species is known previously from three specimens from Puget Sound, Washington. *Harmothoe hartmanae* is distinguished from the cosmopolitan species *H. imbricata* chiefly on the basis of its elytra. This species may be simply a variant of *H. imbricata*, a view suggested previously by Hartman (1959).

Distribution: The northern limits are extended herein to Little Diomede Island.

Harmothoe imbricata (Linnaeus)

Aphrodita imbricata Linnaeus, 1767, p. 1084.
Harmothoe imbricata.—Hartman, 1948, p. 13.—Pettibone, 1954, pp. 220–222, figs. 26a, e.—Hartman, 1961, p. 8.

Material: Stations 35(1), 39(1), 54(21); Bering and Chukchi Seas; silty sand and sandy silt.

Lagisca rarispina (Sars)

Polynoe rarispina Sars 1861, p. 60.
Lagisca rarispina (Sars) Malmgren [sic].—Moore, 1908, pp. 335–336.
Lagisca rarispina Malmgren [sic].—Berkeley and Berkeley, 1948, p. 16, figs. 18–19.
Lagisca rarispina (Sars).—Hartman, 1959, p. 85.

Material: Stations 54(10), 57(1); Bering and Chukchi Seas.

Remarks: Pettibone (1954) listed *L. rarispina* as a synonym of *Harmothoe extenuata* (Grube). Hartman (1959) transferred this latter species to the genus *Lagisca* and listed these two as separate species. The presence of long rod-shaped papillae on the elytrae of *L. rarispina*, lacking on *L. extenuata*, is believed to be of sufficient difference to retain these as separate species.

Distribution: Known from Washington to Chukchi Sea, Hudson Bay, and North Atlantic to depths of 420 meters.

Family Sigalionidae

Pholoe minuta (Fabricius)

Aphrodita minuta Fabricius, 1780, p. 314.
Pholoe minuta.—Pettibone, 1954, pp. 230–231, fig. 26f.

Material: Stations 5(10), 14(4), 15(2), 19(25), 21(2), 33(2), 34(14), 35(7), 39(1), 41B(3), 43(6), 45(8), 46(2), 47(2), 48(4), 49(3), 50(5), 52(8), 53(9), 56(1), 57(4), 60(1), G–1(1), G–5(2); Bering and Chukchi Seas; sandy silt or silty sand.

Family Phyllodocidae

Anaitides groenlandica (Oersted)

Phyllodoce groenlandica Oersted, 1843, p. 192.
Phyllodoce (Anaitides) groenlandica.—Pettibone, 1954, pp. 236–238, figs. 27d, i.—Berkeley and Berkeley, 1956, p. 235.
Anaitides groenlandica.—Hartman, 1948, p. 19.

Material: Stations 50(1), R–3(1); Bering and Beaufort Seas.

Distribution: Northern Hemisphere in depths to 54.8 meters.

Anaitides maculata (Linnaeus)

Nereis maculata Linnaeus, 1767, p. 1086.
Phyllodoce (Anaitides) maculata.—Berkeley and Berkeley, 1948, p. 46, fig. 67.

Material: Stations 25(5), 35(1), 48(1), 49(14), 54(1); Bering Sea; sandy silt.

***Eteone longa* (Fabricius)**

Nereis longa Fabricius, 1780, p. 300.
Eteone longa.—Berkeley and Berkeley, 1948, p. 41, figs. 57, 58.—Pettibone, 1954, p. 234, fig. 27h.

Material: Stations 5(2), 21(1), 27(1), 34(1), 35(4), 42B(1), 50(1), 52(1), 54(2), 58(1), 59(2), 60(2), G–1(1), G–4(1); Bering and Chukchi Seas.

Family Syllidae

***Autolytus prismaticus* (Müller)**

Nereis prismatica Müller, *in* Fabricius, 1780, p. 302.
Autolytus prismaticus (Fabricius) [sic].—Pettibone, 1954, pp. 249–252, figs. 29a–b.

Material: Stations 54(2); Little Diomede Island.

***Exogone naidina* Oersted**

Exogone naidina Oersted, 1845, p. 20, pl. 2.—Pettibone, 1954, p. 258, fig. 281.

Material: Station 25(1); Bering Sea.

***Typosyllis alternata* (Moore)**

Syllis alternata Moore, 1908, pp. 323–325, figs. a–f.
Typosyllis alternata.—Hartman, 1948, p. 21.

Material: Station 57(26); Chukchi Sea; silty sand.

Distribution: This species was known from western Canada south to western Mexico, in shallow waters. The distribution is extended herein into the Chukchi Sea.

***Typosyllis fasciata* (Malmgren)**

Syllis fasciata Malmgren, 1867, p. 161.
Syllis (*Typosyllis*) *fasciata*.—Pettibone, 1954, pp. 254–255, figs. 28c–e.

Material: Station 57(1); Chukchi Sea; silty sand.

Family Nereidae

***Nereis pelagica* Linneaeus**

Nereis pelagica Linnaeus, 1761, p. 508.—Hartman, 1948, p. 26.—Pettibone, 1954, pp. 264–265, figs. 30 a, b.

Material: Station 42B(1); Bering Sea; sandy silt.

Family Sphaerodoridae

***Sphaerodorum minutum* (Webster and Benedict)**

Ephesia minuta Webster and Benedict 1887, p. 728, pl. 4, figs. 64–66.—Chamberlin, 1920, p. 13B.
Sphaerodorum minutum.—Berkeley and Berkeley, 1948, pp. 27–28, fig. 34.—Hartman, 1961, p. 80.

Material: Station G–4(1); Chukchi Sea.

Distribution: In shallow depths from Arctic Ocean, Alaska to southern California, North Atlantic and New England.

Family Nephtyidae

Micronephthys minuta (Théel)

Nephthys [sic] *minuta* Théel, 1879, pp. 28–31, pl. 2, fig. 18.—Uschakov, 1955, p. 217, pl. 68, fig. Zh.
Micronephthys minuta.—Friedrich, 1939, p. 123.—Hartman, 1950, p. 130.

Material: Stations 7(2), 14(1), 21(2), 33(5), 35(1), 39(1), 41B(1), 42B(1), 43(1), 45(1), 49(2), 50(1), 52(2), 55(2), 56(1), 59(1), G–1(3), G–5(2), B(1); sandy silt or silty sand; 16.5 to 143.8 meters.

Distribution: Previously known from the Russian Arctic Ocean; this report extends the distribution of *M. minuta* into Bering, Chukchi, and Beaufort Seas.

Nephtys ciliata (Müller)

Nereis ciliata Müller, 1789, p. 14, pl. 89, figs. 1–4.
Nephtys ciliata.—Hartman, 1950, p. 95.—Pettibone, 1954, p. 270, fig. 30n.

Material; Stations 5(1), 12(1), 15(1); Bering Sea; silty sand or sandy silt.

Nephtys longosetosa Oersted

Nephtys longosetosa Oersted, 1843, p. 195, pl. 6, figs. 75–76.—Berkeley and Berkeley, 1948, p. 52, fig. 76.—Pettibone, 1954, p. 268, fig. 30l.

Material: Stations 13(1), 17(2), 30(1), R–1(1); Bering and Beaufort Seas; sandy silt.

Nephtys paradoxa Malm

Nephthys [sic] *paradoxa* Malm, 1874, p. 78, pl. 1, fig. 2.
Nephtys paradoxa.—Hartman, 1950, p. 111.—Pettibone, 1954, pp. 271–272, figs. 30j–k.

Material: Station G–5(1); Chukchi Sea.

Family Goniadidae

Glycinde wireni Arwidsson

Glycinde wireni Arwidsson, 1899, pp. 53–54, pl. 3, figs. 48–49.—Pettibone, 1954, pp. 274–275, figs. 31e–g.—Levenstein, 1960, p. 116.

Material: Stations 5(88), 7(1), 14(1), 15(1), 17(1), 19(3), 21(1), 34(2), 35(5), 40(3), 41B(2), 42B(1), 43(3), 45(8), 46(22), 47(15), 50(10), 52(13), 53(5), 55(2), 56(1), 57(5), 59(1), 60(1), G–5(1); Bering and Chuckchi Seas; silty sand or sandy silts.

Family Lumbrineridae

Lumbrineris fragilis (Müller)

Lumbricus fragilis Müller, 1776, p. 216.
Lumbrineris fragilis.—Pettibone, 1954, pp. 275–276, figs. 31h–n.

Material: Stations 26(1), 28(1), 57(5), G–2(1), G–3(1), G–6(1), B(6); Bering, Chuckchi, and Beaufort Seas; silty sand or sandy silt.

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Family Orbiniidae

Haploscoloplos elongatus (Johnson)

Scoloplos elongata Johnson, 1901, pp. 412–413, pl. 10, figs. 105–110.
Haploscoloplos elongatus.—Hartman, 1957, pp. 273–275, pl. 26, figs. 1–11. —Berkeley and Berkeley, 1956, pp. 802–4.—Hartman, 1961, p. 26.

Material: Stations 5(42), 8(1), 28(3), 32(1), 33(10), 34(8), 35(6), 39(5), 40(1), 42B(47), 43(7), 45(5), 46(2), 47(2), 48(6), 49(14), 50(3), 52(18), 55(3), 57(5), 58(1), 59(1), 60(17), G–6(1), B(3), C(1), R–2(1), R–3(2); sandy silt or silty sand.

Remarks: Recently Imajima (1963) identified, with reservation, two specimens from Okhotsk Sea as belonging to this species. These specimens lacked furcate setae in abdominal notopodia.

Distribution: *Haploscoloplos elongatus* was known previously from the Icy Cape, Alaska, south to western Mexico. The distribution of this species is extended herein into the Beaufort Sea.

Naineris quadricuspida (Fabricius)

Nais quadricuspida Fabricius, 1780, p. 315.
Naineris quadricuspida.—Fauvel, 1927, pp. 23–24, figs. 8a–g.—Uschakov, 1955, p. 260, pl. 37E, fig. Zh.

Material: Stations 54(1), Little Diomede Island.

Distribution: This species is known from the North Atlantic, Arctic, and Russian Pacific Oceans. Hartman (1961) found a single individual off Santa Catalina Island that she stated agrees most nearly with *N. quadricuspida*. This report is the first for this species in Alaska.

Scoloplos armiger (Müller)

Lumbricus armiger Müller, 1776, p. 215.
Scoloplos armiger.—Pettibone, 1954, pp. 78–280, figs. 32a–e.—Hartman, 1957, pp. 280–282, pl. 29, figs. 1–7.

Material: Stations 15(3), 18(1), 19(1), 21(3), 26(1), 41B(4), 45(1), 52(1); Bering Sea; silty sand or sandy silt.

Family Apistobranchidae

Skardaria fragmentata Wesenberg-Lund

Skardaria fragmentata Wesenberg-Lund, 1951, pp. 59–65, figs. 1–4.—Hartman, 1961, pp. 88–89.

Material: Stations 5(1), 19(14), R–3(1); sand; 12.8 to 67.1 meters depth.

Distribution: This species is known only from the two reports cited above and the present findings. The type locality is Iceland in six meters. Hartman (1961) reported it from southern California.

Family Paraonidae

Aricidea suecica? Eliason

Aricidea suecica Eliason, 1920, pp. 52–55, figs. 14–15.

Material: Station 19(1). An anterior fragment comes from Bering Sea from fine sand in 132 feet.

Remarks: Only an anterior fragment present in these collections. It resembles *A. suecica* Eliason as reported by Hartman (1948) as *A. heteroseta* Hartman (see Hartman, 1957, pp. 318–319), but since this specimen lacked a posterior end, positive identification could not be made. *Aricidea suecica* is known from Denmark, British Isles, southern Alaska, and possibly (fide Hartman, 1957) western Canada and Russian Arctic localities.

Paraonis gracilis (Tauber)

Aonides gracilis Tauber, 1879, p. 115.

Paraonis gracilis.—Uschakov, 1955, p. 286, pl. 103, figs. A, B.—Hartman, 1957, pp. 330–331, pl. 44, figs. 4–5.

Material: Stations 5(2), 17(1), 35(6), 43(1), 50(1), 57(1), G–4(1); Bering and Chukchi Seas; sandy silt or silty sand.

Distribution: Widely distributed from the Arctic to the Antarctic in the Atlantic, the Russian Pacific, and the Bering and Chukchi Seas.

Family Magelonidae

Magelona alata, new species

Figure 2

Material: Stations 5(4), 7(1), 15(1), 17(1), 19(1), 34(1), 35(2), 49(1), 50(4), 57(1), and 60(3); Bering Sea and Beaufort Seas.

Description: Three of 24 specimens complete and in poor condition. Length 4–5 mm. with 22–27 setigerous segments. Some incomplete specimens 4 to 20 mm. in length with 7–65 setigerous segments. Holotype incomplete, 12 mm. long with 17 segments. One specimen from Station 50 with brown pigment laterally on segments 8–17; all other specimens colorless. Pygidium lacking anal processes.

Prostomium broad with frontal horns (fig. 2*a*); with crescent-shaped cephalic ridges. Two palpi generally present, densely papillated.

Parapodia of segments 1–8 similar (fig. 2*b*), notopodium with small presetal lobe, well-developed folioceous postsetal lobe. Dorsal cirrus becoming progressively smaller towards posterior thoracic region. Neuropodial presetal lobe small, postsetal lobe folioceous but becoming small in posterior thoracic region. Single-winged capillary setae (fig. 2*c*), numbering about 20 per each lobe of parapodium, present through segment 9. Segment 9 constricted.

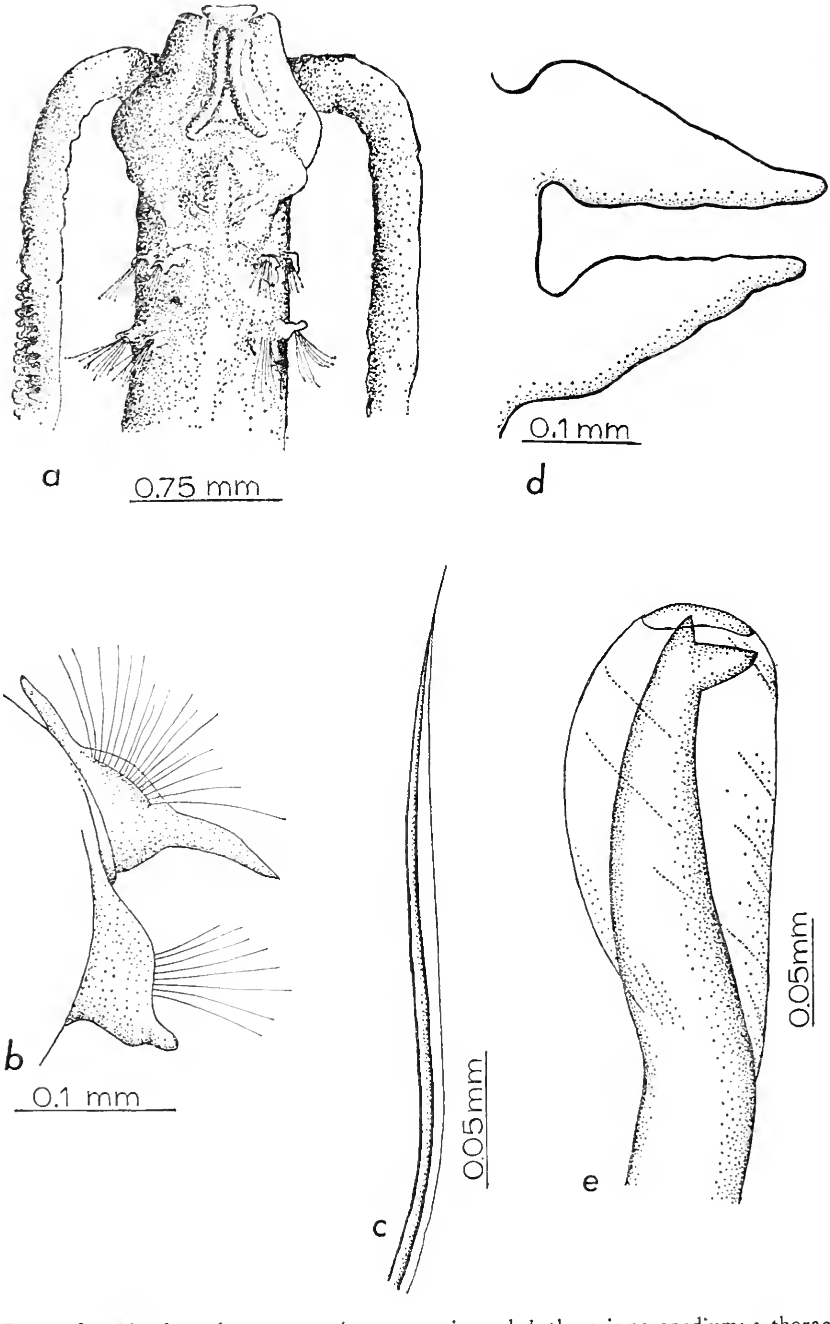

FIGURE 2.—*Magelona alata*, new species: *a*, anterior end; *b*, thoracic parapodium; *c*, thoracic capillary seta; *d*, abdominal parapodium; *e*, abdominal hooded hook.

Abdominal postsetal lobes of notopodium and neuropodium folioceous (fig. 2*d*). Dorsal cirrus lacking. Setae all hooded hooks consisting of two teeth at nearly right angles (fig. 2*e*), numbering about 12 per each lobe of parapodium.

Remarks: Twenty-one species have been described previously for the genus *Magelona*. Jones (1963) recently listed the known species and included a key to these species. *Magelona alata* belongs to that group of nine species possessing bidentate hooded hooks in the posterior region. This group can be divided further by the presence or absence of frontal horns. *Magelona alata* has frontal horns as do *M. annulata* Hartman-Schröder (1962), *M. phyllisae* Jones (1963), *M. longicornis* Johnson (1901), *M. pacifica* Monro (1933), and *M. cerae* Hartman and Reish (1950). *Magelona alata, M. pacifica,* and *M. phyllisae* all have single-winged capillary setae through segment 9. These three species can be distinguished by the different degree of development of the parapodial lobes.

Ecology: *Magelona alata* was taken in depths of 11–67.1 meters, more frequently from silts than from fine and very fine sands.

Type locality: Station 5 (fig. 1), Bristol Bay area of Bering Sea, 56°54′ north latitude and 163°45′ west longitude at a depth of 67.1 meters.

Type material: Holotype, three paratypes, and additional specimens have been deposited in the U.S. National Museum.

Family Spionidae

Prionospio malmgreni Claparède

Prionospio malmgreni Claparède, 1870, p. 73.—Hartman, 1948, p. 36; 1961, p. 29. —Pettibone, 1954, pp. 282–284, figs. 32i–k.

Material: Stations 21(1), 43(1), G–1(1), G–5(1), B(5), R-4(1); Bering, Chukchi, and Beaufort Seas; fine sand or silt.

Spio filicornis (Müller)

Nereis filicornis Müller, 1776, p. 218.
Spio filicornis.—Hartman, 1941, p. 293.—Pettibone, 1954, pp. 284–285, figs. f–h.

Material: Stations 5(1); Bering Sea; silt.

Spiophanes bombyx (Claparède)

Spio bombyx. Claparède, 1870, p. 485.
Spiophanes bombyx.—Berkeley and Berkeley, 1952, pp. 22–24, figs. 42–43.—Hartman, 1961, p. 50.

Material: Stations 15(1), 34(2), 53(1); Beaufort Sea; fine or very fine sand.

Distribution: Known previously from the Mediterranean Sea, Vancouver Island south to California and Japan. These four speci-

mens in Bering Sea extend its northward distribution in the Western Hemisphere.

Family Cirratulidae

Chaetozone setosa Malmgren

Chaetozone setosa Malmgren, 1867, p. 96, pl. 14, fig. 84.—Pettibone, 1954, pp. 287–288, fig. 33d.—Hartman, 1961, p. 109.

Material: Stations G–5(3); Chukchi Sea.

Cirratulus cirratus (Müller)

Lumbricus cirratus Müller, 1776, p. 214.
Cirratulus cirratus.—Pettibone, 1954, pp. 286–287, figs. 33a–c.—Hartman, 1961, p. 105.

Material: Stations 54(4); Little Diomede Island.

Cossura longocirrata Webster and Benedict

Cossura longocirrata Webster and Benedict, 1887, p. 743.—Uschakov, 1955, p. 305, pl. 112, fig. Zh.—Berkeley and Berkeley, 1956, pp. 544–545.

Material: Stations 5(69), 33(1), 42B(8), 43(1), 52(12), 55(8), 56(23), 59(10), 60(3), G–1(2); Bering and Beaufort Seas; silty or very fine sands.

Distribution: This species was reported originally from Maine; subsequently it has been found in North Atlantic, Russian Pacific, and the state of Washington. These reports from the Bering and Chukchi Seas represent new localities for this species.

Tharyx multifilis? Moore

Tharyx multifilis Moore, 1909, pp. 267–268, pl. 9, fig. 43.—Berkeley and Berkeley, 1952, pp. 34–35, fig. 62.

Material: Stations 5(38), 8(1), 26(2), 28(1), 29(1), 32(1), 33(5), 35(5), 43(6), 45(3), 46(11), 47(14), 49(21), 50(11), 52(6), 55(2), 56(1), 57(2), 58(3), 59(7), 60(2), G–3(3), G–4(2), G–5(2), R–1(3), R–3(1).

Ecology: This polychaete was found chiefly from the stations with silts; a few specimens were taken from either fine or very fine sandy bottoms.

Remarks: Morphologically and ecologically these specimens resemble *T. multifilis* with the exception of the small size (10–15 mm.) of the present material. These specimens lack the dark-colored cardiac body as characterized by the smaller and related species *T. parvus* Berkeley. Because of the size difference and because of the few distinguishing characters in this genus, I am referring this material questionably to *T. multifilis*.

Distribution: Vancouver Island to southern California.

Family Flabelligeridae

Brada villosa (Rathke)

Siphonostoma villosum Rathke, 1843, p. 215, pl. 11, figs. 11–12.
Brada villosa.—Berkeley and Berkeley, 1952, p. 7, fig. 5.—Pettibone, 1954, pp. 290–292.

Material: Stations 31(3), 49(1), R–1(1); Bering and Beaufort Seas; silt.

Family Scalibregmidae

Scalibregma inflatum Rathke

Scalibregma inflatum Rathke, 1843, p. 40.—Hartman, 1948, p. 40.—Pettibone, 1954, pp. 293–294, figs. 33i–k.

Material: Stations 33(1), 51(1), 58(1), 59(1), R–2(1); Bering, Chukchi, and Beaufort Seas; silt.

Family Opheliidae

Ammotrypane aulogaster Rathke

Ammotrypane aulogaster Rathke, 1843, p. 199.—Berkeley and Berkeley, 1952, p. 92, figs. 186–187.—Uschakov, 1955, pp. 320–321, pl. 118, figs. A–L.—Hartman, p. 33.

Material: Stations 5(2), 34(1), 41(1), 48(1); Bering Sea; silt or very fine sands.

Distribution: Cosmopolitan, in moderate depths. This is the first report of *A. aulogaster* from the Bering Sea.

Ophelia borealis Quatrefages

Ophelia borealis Quatrefages, 1865, p. 273.—Tebble, 1952, pp. 553–560, figs. 1–3; 1953, p. 362.

Material: Stations 48(1); silt.

Distribution: Previously known from Greenland, North Sea, and Irish Sea; this report extends its distribution into the Bering Sea.

Travisia brevis Moore

Travisia brevis Moore, 1923, pp. 220–221.—Berkeley and Berkeley, 1952, pp. 90–91, fig. 183.—Hartman, 1961, p. 34.—Imajima, 1963, p. 361.

Material: Stations 26(2), 40(2), C(1); very fine sands.

Distribution: This species is known from Okhotsk, Bering, and Beaufort Seas and from Humpback, Alaska, to southern California.

Family Sternaspidae

Sternaspis scutata (Vanzani)

Thalassema scutata Ranzani, 1817, p. 1457, pl. 11, figs. 10–13.
Sternaspis scutata.—Pettibone, 1954, pp. 309–310, figs. 35a–b.

Material: Stations 5(5), 17(1), 35(1), 47(1), 48(1), 49(27), 50(4),

52(6), 55(2), 56(1), 57(1), B(5), R-2(11), R-3(57); Bering, Chukchi, and Beaufort Seas; sandy silt, silty sands, or silts.

Family Capitellidae

Capitella capitata (Fabricius)

Lumbricus capitatus Fabricius, 1780, p. 279.
Capitella capitata.—Pettibone, 1954, pp. 298–299, figs. 33r–u.

Material: Stations 54(5), 2(1), 6(1); Little Diomede Island and Chukchi Sea.

Remarks: One specimen collected at Little Diomede Island on July 30, 1956, was incubating eggs within its tube.

Heteromastus filiformis (Claparède)

Capitella filiformis Claparède, 1864, p. 509, pl. 4, fig. 10.
Heteromastus filiformis.—Hartman, 1948, p. 41; 1951a, p. 102.—Uschakov, 1955, p. 327, pl. 121, fig. D.—Levenstein, 1960, p. 109.

Material: Stations 5(12), 30(1), 34(2), 35(2), 47(7), 48(6), 50(1), 52(4), 53(2), 55(3), 56(4), 57(3), 59(9), 60(8); Bering and Chukchi Seas; silts.

Distribution: Widely distributed in the Northern Hemisphere; previously it has been reported from the West Bering Sea by Levenstein. This is the first report of *H. filiformis* from Chukchi Sea.

Family Maldinidae

Maldane sarsi Malmgren

Maldane sarsi Malmgren, 1865, p. 188.—Pettibone, 1954, pp. 303–304, figs. 34g–h.—Hartman, 1961, p. 37.

Material: Stations 55(9), 56(73), 60(1), G-3(1), G-5(1), G-6(2), B(5); Chukchi and Beaufort Seas; silts.

Nicomache lumbricalis (Fabricius)

Sabella lumbricalis Fabricius, 1780, p. 374.
Nicomache lumbricalis.—Berkeley and Berkeley, 1952, pp. 54–55, figs. 111–112. —Pettibone, 1954, pp. 305–306, figs. 34i–j.

Material: Stations 59(2), B(1); Chukchi and Beaufort Seas; silts.

Petaloproctus tenuis (Théel)

Maldane tenuis Théel, 1879, p. 57.
Petaloproctus tenuis.—Berkeley and Berkeley, 1952, pp. 55–56, fig. 113. —Pettibone, 1954, pp. 306–307, figs. 34l–m.—Uschakov, 1955, p. 339. —Hartman, 1961, p. 37.

Material: Station R-4(1); Beaufort Sea.

Praxillella praetermissa (Malmgren)

Praxilla praetermissa Malmgren, 1865, p. 191.
Praxillella praetermissa.—Pettibone, 1954, p. 303, figs. 34b–f.—Uschakov, 1955, p. 341.—Berkeley and Berkeley, 1956, p. 238.—Levenstein, 1960, p. 121.

Material: Stations 5(1), 7(1), 21(1), 27(1), 34(1), 35(2), 40(1), 41B(1), 49(1), 50(1), 52(2), 58(1); Bering and Chukchi Seas; variety of substrate types.

Rhodine bitorquata Moore

Rhodine bitorquata Moore, 1923, pp. 223–225, pl. 18, fig. 30.—Berkeley and Berkeley, 1952, pp. 52–53, figs. 107–108.—Hartman, 1961, p. 37.

Material: Stations 29(2), 39(1), 40(3), 43(3), 52(2), 56(8), 57(3); variety of substrate types.

Distribution: This species was known previously from Vancouver Island to southern California. The discovery of *R. bitorquata* in the Bering and Chukchi Seas extends its northern distribution.

Family Oweniidae

Myriochele heeri Malmgren

Myriochele heeri Malmgren, 1867, p. 211.—Fauvel, 1927, pp. 204–205, fig. 71h–m.—Berkeley and Berkeley, 1956, p. 238.

Material: Stations 5(1), 26(2), 27(1), 28(3), 34(495), 35(971), 39(1), 43(189), 45(677), 46(7), 48(98), 50(501), 52(2), 53(10), 57(3); Bering Sea; silts, fine and very fine sands.

Distribution: Widely distributed throughout the colder waters of the Northern Hemisphere.

Family Sabellariidae

Idanthyrsus ornamentatus Chamberlin

Idanthyrsus ornamentatus Chamberlin, 1919, pp. 262–263, pl. 3, figs. 2–5.—Hartman, 1944, p. 337, pl. 31, fig. 34.

Material: Stations 42B(2), 49(3), 52(1), 57(4); Bering Sea; silts or very fine sands.

Remarks: Okuda (1938) regarded *I. ornamentatus* Chamberlin as a synonym of *I. armatus.* This viewpoint was followed by Pettibone (1954) but not Hartman (1944). The present material from the Bering and Chukchi Seas agrees with the account by Hartman. Detailed comparisons of these two species from various localities are warranted to determine whether or not one or two species are involved.

Distribution: Given by Hartman (1948) as northern California to Alaska.

Family Pectinariidae

Cistenides granulata (Linnaeus)

Sabella granulata Linnaeus, 1767, p. 1268.
Pectinaria (*Cistenides*) *granulata* (Linnaeus).—Pettibone, 1954, pp. 312–314, figs. 35i–k.

Material: Stations 57(1), R–2(10), R–3(5); Chukchi and Beaufort Seas; silts.

Family Ampharetidae

Ampharete acutifrons (Grube)

Amphicteis acutifrons Grube, 1860, p. 109, pl. 5, fig. 6.
Ampharete acutifrons.—Pettibone, 1954, pp. 316–317, figs. 36b–d.—Uschakov, 1955, p. 366, pl. 136, figs. A–U.—Hartman, 1961, p. 39.

Material: Stations 46(2), 57(3), G–6(4), B(1); Bering and Chukchi Seas; silt.

Asabellides sibirica (Wirén)

Sabellides sibirica Wirén, 1883, p. 418.
Asabellides sibirica.—Pettibone, 1954, p. 318, fig. 36e.—Uschakov, 1955, p. 371, pl. 137, figs. H–T.—Berkeley and Berkeley, 1956, pp. 240–241.

Material: Stations 5(1), 46(2), B(2), R–2(2), R–3(2); Bering, Chukchi, and Beaufort Seas; silt.

Family Terebellidae

Amphitrite cirrata Müller

Amphitrite cirrata Müller, 1776, p. 188.—Berkeley and Berkeley, 1952, p. 86, fig. 175.—Pettibone, 1954, pp. 321–322, figs. 36g–h.

Material: Stations 54(2); Little Diomede Island.

Lysilla loveni Malmgren

Lysilla loveni Malmgren, 1866, p. 393.—Fauvel, 1927, pp. 286–287, figs. 99f–i.—Uschakov, 1955, p. 403, pl. 150, fig. G.

Material: Stations G–5(1); Chukchi Sea.

Distribution: Arctic Ocean, North Atlantic, Chukchi Sea, and Sea of Japan; shallow water to 338.9 meters.

Nicolea zostericola (Oersted)

Terebella zostericola Oersted *in* Grube, 1860, p. 98.
Nicolea zostericola.—Fauvel, 1927, pp. 261–262, figs. 90g–n.—Berkeley and Berkeley, 1952, pp. 87–88, figs. 177–178.—Uschakov, 1955, p. 390, pl. 146, figs. B, G.

Material: Stations 54(1): Little Diomede Island.

Remarks: Fauvel (1927) separated *N. zostericola* from *N. venustula* on the basis of 15 thoracic segments in the former and 17 in the latter.

Wesenberg-Lund (1950) regarded *N. zostericola* as a synonym of *N. venustula* because specimens from a single locality possessed 15–17 thoracic segments. Pettibone (1954) concurred with this. Herpin (1925, *in* Wesenberg-Lund, 1950) found a difference in egg-laying habits between these two. I believe additional data, especially developmental, are needed before this question can be resolved. I am retaining the use of *N. zostericola* to indicate the specimen from Little Diomede Island possessed 15 thoracic segments.

Distribution: Arctic Ocean, North Atlantic Ocean, Little Diomede Island, British Columbia, Russian Pacific.

***Thelepus cincinnatus* (Fabricius)**

Amphitrite cincinnata Fabricius, 1780, p. 286.
Thelepus cincinnatus.—Pettibone, 1954, pp. 327–328, fig. 37d.

Material: Station 57(1); Chukchi Sea; silt.

Family Trichobranchidae

***Terebellides stroemi* Sars**

Terebellides stroemi Sars, 1835, p. 48.—Berkeley and Berkeley, 1952, pp. 75–76, figs. 152–153.—Pettibone, 1954, pp. 330–332, figs. 37j–m.—Reish, 1959, p. 39.—Hartman, 1960, p. 162.

Material: Stations 35(1), 41B(1), 43(1), 45(1), 57(4), 58(2), 60(1), G-4(1), G–5(1), R–3(1); Bering, Chukchi, and Beaufort Seas; variety of substrate types.

Family Sabellidae

***Chone duneri* Malmgren**

Chone duneri Malmgren, 1867, p. 116, pl. 13, fig. 75.—Pettibone, 1954, p. 339, figs. 39k–l.—Uschakov, 1955, p. 418.

Material: Stations 42B(1); Bering Sea; silt.

***Chone infundibuliformis* Kröyer**

Chone infundibuliformis Kröyer, 1856, p. 33.—Berkeley and Berkeley, 1952, p. 123, figs. 252–253.—Pettibone, 1954, pp. 338–339, figs. 39a–j.—Hartman, 1961, p. 42.

Material: Stations 35(14); Bering Sea; very fine sand.

***Euchone analis* (Kröyer)**

Sabella analis Kröyer, 1856, p. 17.—Hartman, 195lb, p. 381.—Pettibone, 1954, pp. 339–340, figs. 39 m–n.

Material: Station 35(1); Bering Sea; silt.

Euchone trisegmentata, new species

FIGURE 3

Material: Station 5(7).

Description: All specimens complete, measured 5–7 mm. long, including the tentacles, and 0.3 mm. wide. All have 8 thoracic and 9 abdominal segments; the last 3 abdominal segments comprise the anal depression (fig. 3*a*). Two specimens contained ova in the coelom. Branchial crown with 3 pinnate radioles per side, each radiole with numerous filaments and united by a membrane for ⅓ of their length. Collar little developed dorsally but is produced centrally into two lobes.

Thoracic notopodia composed of superior single-winged capillary setae (fig. 4*b*) and inferior subspatulate setae (fig. 4*c*). Thoracic neuropodial long-handled uncini provided with a large tooth and six smaller ones (fig. 4*d*).

Anterior abdominal notopodia with acicular hooks, each with a large tooth and nine smaller teeth (fig. 4*e*). Setae of neuropodium and anal depression region are simple capillary ones.

Remarks: Ten species of the genus *Euchone* are known from the Pacific Ocean. *Euchone trisegmentata* comes closest to *E. rosea* Langerhans. Both species are the smallest known members of the genus and each have only 17 setigerous segments, the fewest number known; however, there are 4 segments to the anal depression in *E. rosea* and only 3 in *E. trisegmentata*. There are 5 radioles per side in *E. rosea* and only 3 in *E. trisegmentata*. The types of setae are similar in both species but vary in shape and in the number of secondary teeth in the long-handled uncini and acicular hooks.

Ecology: *Euchone trisegmentata* was taken from a substrate composed of silts at a depth of 67.1 meters. Sixteen additional species of polychaetes were present in this quantitative sample. The dominant species were *Glycinde wireni* (88 specimens), *Cossura longocirrata* (69), *Haploscoloplos elongatus* (42), and *Tharyx multifilis*? (38).

Type locality: Station 5 (fig. 1), Bristol Bay area of Bering Sea, 56°54′ north latitude and 163°45′ west longitude at a depth of 67.1 meters.

Type material: The holotype and six paratypes have been deposited in the U.S. National Museum.

Potamilla neglecta (Sars)

Sabella neglecta Sars, 1851, p. 203.

Potamilla neglecta.—Hartman, 1948, p. 46.—Wesenberg-Lund, 1950, pp. 56–57 pl. 10, figs. 47–48.—Berkeley and Berkeley, 1952, p. 116, fig. 238.—Pettibone 1954, pp. 335–336, figs. 38j–n.—Uschakov, 1955, p. 409.

Material: Stations 57(20), R–3(1); Chukchi and Beaufort Seas.

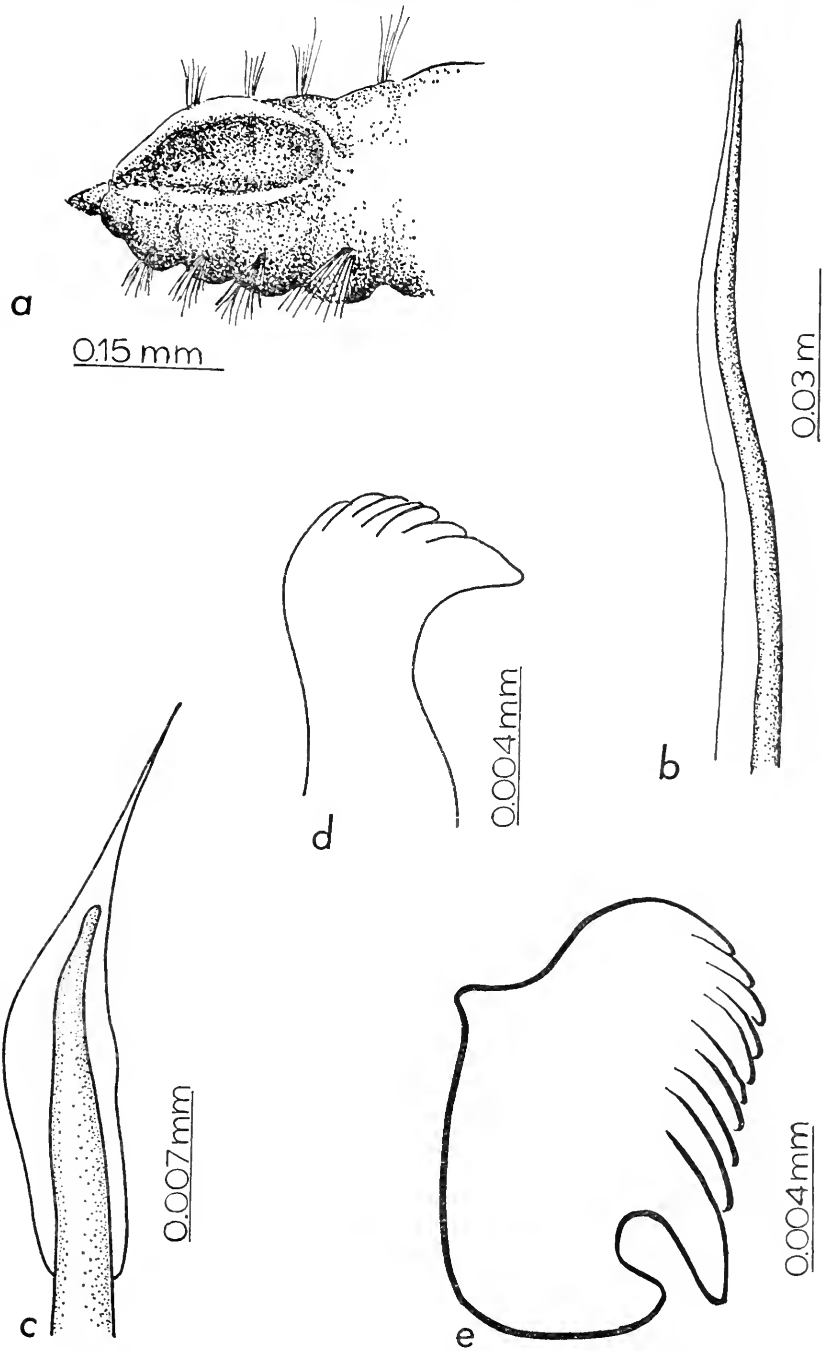

FIGURE 3.—*Euchone trisegmentata*, new species: *a*, posterior end; *b*, thoracic notopodial capillary seta; *c*, thoracic notopodial subspatulate seta; *d*, thoracic neuropodial uncinus; *e*, abdominal notopodial avicular hooks.

Pseudopotamilla reniformis (Müller)

Amphitrite reniformis Müller, 1771, p. 194.
Sabella reniformis Leukart [sic], 1849, p. 183, pl. 3, fig. 8.
Potamilla reniformis (Müller).—Wesenberg-Lund, 1950, p. 57.
Pseudopotamilla reniformis (Leuckart) [sic].—Berkeley and Berkeley, 1952, pp. 116–117, fig. 239.
Potamilla reniformis (Leuckart) [sic].—Pettibone, 1954, pp. 336–337, figs. 30o–u.
Pseudopotamilla reniformis (Müller).—Hartman, 1945, p. 47.

Material: Station 57(1); Chukchi Sea; silt.

Family Serpulidae

Dexiospira spirillum (Linnaeus)

Serpula spirillum Linnaeus, 1758, p. 785.
Spirorbis (*Dexiospira*) *spirillum*.—Berkeley and Berkeley, 1952, p. 133, figs. 272–274.—Pettibone, 1954, pp. 344–345, figs. 39u–x.

Material: Station 54(4); Little Diomede Island.

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HAUSTORIIDAE OF NEW ENGLAND (CRUSTACEA: AMPHIPODA)

By E. L. Bousfield[1]

Introduction

The family Haustoriidae embraces a heterogeneous group of gammaridean amphipods that are variously adapted for burrowing and filtering minute food particles from the substratum.

Partly because of their restricted ecology, fossorial habits, and small size, relatively few of these remarkable crustaceans were described or recorded from American-Atlantic and New England waters by early carcinologists. Holmes (1904) recorded *Pontoporeia femorata* Krøyer from "somewhere on the New England coast" and amplified the earlier records of Smith (1874, 1880) for "*Haustorius arenarius*" (Slabber) in the Cape Cod region. Paulmier (1905) and Kunkel (1918) recorded and figured this European species from coastal waters of New York City and the state of Connecticut, respectively. The writer (1962b) tentatively synonymized Paulmier's species with *Haustorius canadensis*, newly described from the Gulf of St. Lawrence, and simultaneously (1962b) diagnosed a further species, *Haustorius spinosus*, from shore localities in the Bay of Fundy.

A number of other haustoriid species, recorded or described from the Bay of Fundy and elsewhere in eastern Canada, were believed to

[1] Department of the Secretary of State, National Museum of Canada, Ottawa.

range southward at least into coastal waters of northern New England and probably throughout the Gulf of Maine. These included two species of the genus *Amphiporeia*, *A. lawrenciana* Shoemaker (1929, 1930) and *A. virginiana* Shoemaker (1933), as well as *Bathyporeia quoddyensis* Shoemaker (1941) and *Priscillina armata* (Boeck) 1861. *Pontoporeia affinis* Lindstrom 1875, commonly encountered in arctic and subarctic intertidal and estuarine localities of eastern Canada (Dunbar, 1954; Bousfield, (1956a) and also known from fresh-water Lake Chamberlain in northern Maine (Bousfield, 1958a), less probably occurs in New England coastal marine waters. Doubtfully occurring in the region is the puzzling *Lepidactylus dytiscus* Say 1818, originally described from the coast of Georgia, and *Haustorius americanus* Pearse 1908, collected at Cameron, La., but not recorded elsewhere. North American species of the genus *Eohaustorius* Barnard 1957 apparently are restricted to the North Pacific region, and species of the cold-temperate genus *Urothöe* have not been recorded from the western Atlantic, although well known from the European and African coasts. Thus, the previously known or probable haustoriid fauna of New England consisted of less than a dozen species in five or six genera.

As a sequel to the studies on *Haustorius* in eastern Canada (Bousfield, 1962b), the writer examined considerable material of this genus from the New England coast, particularly from localities in the Cape Cod region. Much of the material was collected during the past five or six years, particularly during the period June–September 1963; the remainder consisted of the original study material of S. I. Smith, Samuel Holmes, C. R. Shoemaker, and their associates, now stored at the Yale Peabody Museum, the Harvard Museum of Comparative Zoology, and the United States National Museum in Washington.

A number of distinct types have been discovered, the diversity of which is believed sufficient for new generic as well as new specific recognition. The affinities of these new taxa provide the basis for subfamily differentiation within the heterogeneous complex of the Haustoriidae. This study, therefore, is an attempt to combine the previous information with the present findings, to redefine the family Haustoriidae and the type genus *Haustorius*, and to propose a new phylogenetic concept within the systematic unit.

Herewith, newly described, are the subfamilies Pontoporeiinae and Haustoriinae, the genera *Protohaustorius*, *Parahaustorius*, *Neohaustorius*, *Pseudohaustorius*, and *Acanthohaustorius*, and the species *Protohaustorius deichmannae* and *P. wigleyi*, *Parahaustorius longimerus*, *P. holmesi*, and *P. attenuatus*, *Neohaustorius biarticulatus* and *N. schmitzi*, *Pseudohaustorius caroliniensis* and *P. borealis*, and *Acanthohaustorius millsi*, *A. intermedius* and *A. shoemakeri*. *Haustorius*

spinosus Bousfield is placed in the genus *Acanthohaustorius* and the morphological variation and geographical range of *Haustorius canadensis* is more fully delimited. The known and probable New England haustoriid fauna now includes 20 species in 10 genera and 2 subfamilies.

The following abbreviations are used throughout the figure legends:

A	antenna
EP	epimeron
GN	gnathopod
HD	head and antennae, without setae
LFT	left
LL	lower lip
MD	mandible
MX	maxilla
MXPD	maxilliped
P	peraeopod
PED	peduncle
PL	pleopod
PUD	pleosome and urosome, dorsal aspect
PUL	pleosome and urosome, lateral aspect
RT	right
T	telson
U	uropod
UL	upper lip

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The following abbreviations are used throughout the text:

NMC	National Museum of Canada, Ottawa
MBL	Marine Biological Laboratory, Woods Hole, Mass.
USFW	United States Fish and Wildlife Service, Washington, D.C.
USFC	United States Fish Commission
USNM	United States National Museum, Washington, D.C.
YPM	Yale Peabody Museum, New Haven, Conn.

Evolution and Phylogeny

The family Haustoriidae is a relatively ancient and morphologically primitive group of gammaridean Amphipoda. The para-ancestral haustoriids (cf. *Pontoporeia*) are only slightly more specialized for fossorial existence than are some members of the ultraprimitive family Gammaridae (e.g., *Gammarus lawrencianus*), from which stock they

may have arisen. Careful comparison of antennae, mouthparts, gnathopods, uropods, and telson indicates few basic differences between *Pontoporeia* and *Gammarus*, a similarity that is reinforced by the pronounced sexual dimorphism and similar mating behavior in the two genera. Dennell (1932) concluded that, aside from special secondary modifications of maxillae and maxillipeds, the mouthparts of *Haustorius arenarius* strongly resembled those of *Gammarus locusta*. Only the relatively elongate peraeopod 4, the strongly expanded basos of peraeopod 5, and acute anterolateral headlobes of the Haustoriidae consistently separate members of this family from typical Gammaridae. Ecologically, the two families overlap considerably, with both represented mainly in shallows of marine, brackish, and fresh waters, and with relatively few species in the deep benthos.

The Gammaridae may now be considered to encompass the prototype or the morphologically most primitive species of existing Amphipoda. In the fresh-water *Gammarus lacustris*, for example, the mouthparts and limbs are completely and regularly segmented, fully developed and fully setose, and are the least differentiated or specialized of all known gammarids. The Gammaridae is essentially a freshwater family, with two-thirds of the genera listed in Barnard (1958) being nonmarine. The family is mainly cold-temperate in the northern hemisphere. By contrast, aquatic members of the highly evolved and land-adapted Talitroidea largely occupy the relatively warm fresh waters of the southern hemisphere.

The morphologically most specialized and highly evolved Gammaridae (e.g., *Melita*, *Ceradocus*) are fully marine, warm-temperate or deep-water pelagic forms. Similarly the Haustoriidae are essentially shallow-water, cold-temperate animals, and are represented in freshwater and coldest (high latitude) marine regions by the primitive genus *Pontoporeia*, at intermediate temperatures and latitudes by the more advanced *Amphiporeia*, *Bathyporeia*, and *Priscillina*, and along the warm, low-latitude marine shores by the highly evolved Haustoriinae.

The construction of a hypothetical family tree within the Haustoriidae presents some difficulty because of the likelihood of parallel evolution and morphological convergence in groups of different origin. This phenomenon is illustrated on a broader basis by the fossorial form of *Priscillina*, a form that has evolved independently among such diverse gammaridean families as the Gammaridae (e.g., *Pontogammarus*), the Lysianassidae (e.g., *Tmetonyx nobilis*), the Phoxocephalidae (e.g., *Paraphoxus*), and the superfamily Talitroidea (e.g., *Dogielinotus*). Reliable indices of their true familial relationships are provided by the form of certain mouthparts, especially the mandible and lower lip, by the shape and armature of the female brood plates,

by the form of the first gnathopods, especially in the male, and by the form of the third uropods and telson. The prototype haustoriid, probably not unlike *Pontoporeia affinis,* became specialized along two main lines, still traceable within the Pontoporeiinae. One line, which includes *Amphiporeia* and *Bathyporeia,* retained the slender body and limbs and sexual dimorphism that characterize species of a non-specialized feeding type and loose infaunal association. The other line, leading through *Pontoporeia femorata* to *Priscillina,* evolved the broadly arched body, specialized limbs, powerful pleopods, and similarity of the sexes coincident with a fossorial mode of life. From this second line, and probably in warm temperate regions, evolved the modern haustoriinid with its unique water-pumping and filter-feeding mechanism. Intermediate stages linking the pontoporeiid prototype with the most primitive haustoriinid (e.g., *Protohaustorius*) apparently did not persist to the present time. Within the Haustoriinae, the form of the maxillae in *Pseudohaustorius* and even in *Protohaustorius* might be interpreted as a secondary loss of the filter-feeding mechanism and a return to the typical gammaridean method of feeding on large food particles.

Field behavior.—Present knowledge of the behavior and ecology of the littoral haustoriids of New England is scanty. In the British Isles, the feeding, swimming, and burrowing habits have been described in *Haustorius arenarius* by Dennell (1932), in various species of *Bathyporeia* by Watkin (1939), and in *Urothoe marina* by Watkin (1940). *Haustorius* swims on its back and burrows by a modification of the swimming movements. Burrowing is dependent on the expulsive action of the swimming current and cannot, therefore, be effected in damp or dry sand. The filter feeding mechanism involves the collection of food particles via a forward-directed current in the enlarged plates of maxilla II, its removal by the maxilliped setae, and subsequent transfer to the maxilla I, mandibles, and mouth opening. This mechanism is a secondary development of the raptorial feeding mechanisms in normal gammaridean Amphipoda. Say's excellent description (1818) of *Lepidactylus dytiscus* from the coast of Georgia included details of swimming and burrowing behavior that clearly mark the species as a member of the Haustoriinae.

Zoogeographical and ecological relationships.—The Haustoriidae exhibit considerable ecological diversity in cool-temperate regions of the northern hemisphere. Within the North Atlantic region the Pontoporeiinae are best represented in the subarctic and cold-temperate (boreal) regions whereas the Haustoriinae have radiated mainly in the cool-to-warm-temperate (Virginian and Carolinian) zones. The Cape Cod region of the western Atlantic occupies a position of overlap between the cold-temperate faunas to the north

and the warm-temperate faunas to the south and is thus relatively rich in species of both subfamilies. Some of the species (e.g., in *Neohaustorius, Parahaustorius,* and *Acanthohaustorius*) appear to be endemic to the Cape Cod region although further careful collecting in selected habitats undoubtedly will increase the geographical range, particularly southward, in these instances. Such endemicity, whether real or apparent, is known in other invertebrate groups (e.g., cumaceans, mysids). The wide range of inshore water temperatures in the Cape Cod region, both geographically and bathymetrically, coupled with the absence of extreme or prolonged winter lows and excessive summer highs, enhances the suitability of the habitat and thus contributes significantly to the richness and diversity of its haustoriid fauna. In this respect the region compares favorably with the southern British Isles in the eastern Atlantic and with southern California in the eastern Pacific.

New England haustoriids are essentially intertidal and shallow-water crustaceans. On the outer, surf-exposed sand beaches, especially where sand remains damp at low water through seepage or fresh-water outflows, are found the large *Haustorius canadensis,* the smaller *Amphiporeia virginiana,* and minute *Bathyporeia quoddyensis.* Along semiprotected shores, *H. canadensis* occurs at midwater levels, whereas the somewhat smaller *Parahaustorius longimerus* and *Acanthohaustorius millsi* are dominant near low-water level. Here also, particularly near the mouths of sandy estuaries, *Protohaustorius deichmannae* is often abundant. *Neohaustorius biarticulatus* is restricted to sandy banks of salt marsh creeks. Subtidally and offshore, especially over the southern Georges Bank region and Long Island Sound, occur the larger and more powerful species, such as *Parahaustorius holmesi* and *P. attenuatus,* others of intermediate size, such as *Protohaustorius wigleyi, Pseudohaustorius borealis,* and *Acanthohaustorius shoemakeri. Pseudohaustorius caroliniensis* is an estuarine form of muddy sand and seepage beds from Buzzards Bay southward.

From Casco Bay northward along the outer coasts of Maine and Nova Scotia, *Haustorius canadensis, Acanthohaustorius millsi,* and *Protohaustorius deichmannae* quickly disappear, but the former reappears along the dune beaches in the southwestern Gulf of St. Lawrence and Cape Breton Island (Bousfield, 1964b). Similar habitats of the colder intervening region are populated largely by the isopod *Chiridothea caeca,* whereas the low-water and subtidal levels are dominated by *Amphiporeia lawrenciana,* the minute *Bathyporeia quoddyensis,* and the large lysianassid *Tmetonyx nobilis. Acanthohaustorius spinosus* and *Bathyporeia quoddyensis,* normally subtidal, appear regularly at low-water level of the few sand beaches

of the cold-water Bay of Fundy (Bousfield, 1962a). On smooth, gently sloping, surf-exposed sand beaches, *Amphiporeia virginiana* continues northward along the outer coast of Nova Scotia almost to Cape Breton Island. In corresponding estuaries, *Pontoporeia femorata* frequents the sandy mud channel banks, and *Gammarus lawrencianus*, the sandy eel-grass shallows. North of the Scotian shelf, *Pontoporeia femorata* and *Priscillina armata* dominate suitable bottom sediments, and the subarctic estuaries are populated by *Pontoporeia affinis*, along with *Pseudolibrotus littoralis*, *Oediceros* spp., and other burrowing amphipods.

Southward from New England, the surf-swept beaches are occupied by *Protohaustorius longimerus*, by a long-rostrate species of *Haustorius*, otherwise very similar to *H. canadensis* and *H. arenarius* (Bousfield, in press), and by *Neohaustorius schmitzi*. Although several of these species persist southward to North Carolina and Georgia, an additional complex of haustoriids, particularly in the *Pseudohaustorius* and "*Lepidactylus*" groups, dominate the intertidal and estuarine faunas of the southeastern and Florida-Atlantic coasts.

As previously noted, the relationship between geographical distribution and phylogeny within the Haustoriidae is simulated closely in other families of amphipods. If of broader application, this relationship may prove useful in the interpretation of the origin and probable lines of diversification within the entire gammaridean suborder of the Amphipoda.

Family Haustoriidae

(emendation of Stebbing, 1906)

Gammaridean amphipods with body and appendages adapted for burrowing and mouthparts more or less modified for filtering minute food particles from the interstitial water of bottom sediments. Head and body segments usually broad and deep, plates and appendages of peraeon and pleon tending to form a ventral cylindrical tunnel through which a strong posteriorly directed water current is maintained by the action of the powerful pleopods. Rostrum variously developed, not hoodlike. Eyes small, weakly pigmented or lacking. Antennae short, subequal, usually richly plumose or setose; antenna 1 with short accessory flagellum and calceolate primary flagellum. Mouthparts tending to enlargement of primary plates and development of accessory lobes; mandible with large palp and strong molar, incisor and lacinia usually weak; upper lip squarish or broad-rounded; lower lip: inner lobes distinct, elongate. Coxal plates large, deep, margins setose. Gnathopods usually unlike, weakly subchelate, chelate, or simple. Peraeopods 1 and 2 subequal and usually alike,

dactyls small or lacking. Peraeopods 3–5, basal segments broadly expanded, segments 4 and 5 frequently broad, dactyls small or lacking. Peraeopod 4 longest, 5 slightly shorter, 3 shortest. Peraeon segments 2–6 inclusive with simple, saclike coxal gills. Brood plates variously reduced, small or vestigial on peraeon 3. Pleopods strong, peduncle short, stout. Urosome normal or variously reduced. Uropods normally biramous, 3rd slender, with 2-segmented outer ramus. Telson broad, flattened, entire, deeply cleft or bilobed. Sexes dimorphic, tending to likeness in fossorial species.

Type genus.—*Haustorius* Müller 1775.

Remarks.—The family Haustoriidae resembles the Phoxocephalidae in gross morphology and fossorial habits. The genus *Urothoe*, usually placed in the Haustoriidae, has several characters common to the two families. Although lacking a hooded rostrum, *Urothoe* is closer to *Paraphoxus* and typical Phoxocephalidae in the form of its mouthparts, gnathopods, and peraeopods. The development of raptorial gnathopods, reduced maxillary plates, and weak mandibular molar suggests a carnivorous feeding type in at least some of the Phoxocephalidae, whereas the Haustoriidae are essentially filter feeders and minute particulate scavengers.

Pontoporeiinae, new subfamily

Head and body segments of normal width, seldom tumid or produced laterally. Rostrum weak or lacking. Eyes usually present, well pigmented. Pleon not abruptly narrowing beyond peraeon. Urosome normal, frequently dorsally toothed or pilose; posteroventral lappet lacking. Antenna 1 variously geniculate, peduncular segments 2 and 3 short. Antenna 2: peduncular segments 4 and 5 not lobate or excessively plumose behind.

Mouthparts about normal. Lower lip: inner lobes small, outer lobes with pronounced lateral wings. Mandibular incisor and lacinia moderately developed. Maxilliped palp slender, 4-segmented. Gnathopod 1 subchelate; gnathopod 2 subchelate or simple, usually unlike gnathopod 1. Peraeopods 1 and 2 similar, dactyls present. Peraeopods 3–5: segments 4–5 not expanded, dactyls small or vestigial. Pleopods normal, rami subequal. Uropods 1 and 2 normal, similar, equally biramous, uropod 2 smaller. Uropod 3 large, rami flat, marginally setose, unequal. Telson cleft or bilobed. Sexes dimorphic, female usually the larger. Brood plates large, moderately developed on peraeon 3. In male, flagellum of antenna 2 elongate, bearing platelike calceoli; uropod 3 elongate, natatory.

Type genus.—*Pontoporeia* Krøyer 1842.

Component genera.—*Pontoporeia* Krøyer 1842, *Amphiporeia* Shoemaker 1929, *Bathyporeia* Lindstrom 1855, *Priscillina* Stebbing 1888, *Haustoriopsis* Schellenberg 1938, *Urothöe* Dana 1852(?).

Remarks.—A separate subfamily may be required for *Urothöe,* its deep-sea generic complex, and *Carangolia* Barnard 1961. These genera show many features in common with the Phoxocephalidae including the strongly subchelate and similar gnathopods, large accessory flagellum, equally biramous third uropods, dactylate peraeopods, and slender female brood plates. The mouthparts, with weak mandibular palp, small maxillae, slender maxilliped palp, and broad lower lip, suggest a carnivorous or large-particulate feeding function, rather than the filter-feeding mechanism of typical Haustoriidae.

Haustoriinae, new subfamily

Head and body segments broadly arched, tumid or cylindrical; rostrum usually strong, antennal sinus deep; eyes small, weakly pigmented, or lacking. Peraeon segments produced laterally in short lobes to which limbs are attached; pleon abruptly narrowing beyond peraeon, posterior margin often overhanging urosome. Urosome segments variously reduced, segments short, narrow, dorsally smooth; urosome 1 with posteroventral lappet. Antennal peduncular segments short, broad, margins thickly setose or plumose; antenna 1: flagellum short, usually with elongage calceolae; antennae 2: peduncular segments 4 (occasionally 5), lobate behind, flagellum short, noncalceolate in either sex.

Mouthparts variously modified. Lower lip: inner lobes large, elongate; outer lips laterally rounded. Mandibular palp and molar strong, incisor and lacinia weak, occasionally lacking. Maxilla 1 typically with lateral coxal baler lobe. Maxilla 2: outer plate often large, broad, strongly plumose. Maxilliped palp broad, 3-segmented. Gnathopod 1 simple. Gnathopod 2 minutely chelate, otherwise similar to gnathopod 1. Coxal plates 1–4 deep, posterior angle acute. Peraeopods without dactyls. Peraeopods 1 and 2 powerfully fossorial, usually similar. Peraeopods 3–5: segments 4 and 5 broadly expanded, margins richly spinose and/or plumose. Pleopods strong, peduncles short and broad, outer ramus longer. Uropod 1 strong, spinose, usually unequally biramous, occasionally uniramous. Uropod 2 much smaller and unlike uropod 1, thickly setose, occasionally uniramous. Uropod 3 short, rami subequal, setose at apices. Telson entire, variously cleft, or bilobed. Sexes similar, male smaller. Female brood plates small or vestigial on peraeon 3.

Type genus.—*Haustorius* Müller 1775.

Component genera.—*Haustorius* Müller 1775; *Eohaustorius* Barnard 1957; *Protohaustorius*, new genus; *Parahaustorius*, new genus; *Neohaustorius*, new genus; *Pseudohaustorius*, new genus; *Acanthohaustorius*, new genus.

Remarks.—The status of *Lepidactylus* Say 1818 is being clarified elsewhere (Bousfield, in prep.). Despite the wealth of descriptive detail, Say's species, *L. dytiscus*, cannot be identified with certainty with any of the species or even genera herewith proposed as new. Unfortunately Say's type is not available. Recent studies on material of *Haustorius* (or near relative) endemic to the Atlantic coast of Georgia and Florida indicate that a common intertidal estuarine species, presently being redescribed, is probably Say's species.

Antiboreal genera *Cardenio* Stebbing 1888, *Urohaustorius* Sheard 1937, *Urothoides* Stebbing 1891, *Platyischnopus* Stebbing 1888, and *Phoxocephalopsis* Schellenberg 1931, show characteristics of the present two subfamilies but are distinctive and divergent rather than transitional. Further study of their subfamily affinities, based on fresh material, is suggested.

Key to Genera and Species of Haustoriidae in New England Waters

1. Body usually slender, peracon segments not laterally lobate; rostrum weak or lacking, eyes usually well pigmented; pleosome and urosome normal; gnathopod 1 subchelate; gnathopod 2 simple or subchelate; peraeopods with small dactyls; peraeopods 3–5, segments 4 and 5 not broadened; uropod 2 spinose, similar to but smaller than uropod 1; maxilliped palp slender, 4-segmented; lower lip, outer lobes with lateral wings. Pontoporeiinae. 2

   Body usually broad, peraeon segments laterally lobate; rostrum distinct, eyes weakly pigmented or lacking; pleon usually abruptly narrowing beyond peraeon, urosome variously reduced; gnathopod 1 simple, gnathopod 2 minutely chelate; peraeopods without dactyls; peraeopods 3–5, segments 4 and 5 posteriorly broadened; uropod 2 setose, much smaller than and unlike uropod 1; maxilliped palp 3-segmented; lower lip, outer lobes laterally rounded . . . . Haustoriinae. 7

2. Antennae 1 not geniculate, peduncular segment 1 slightly longer than 2 and 3 combined; peraeopod 3 of normal attitude; uropod 3, outer ramus less than twice the peduncle, terminal segment vestigial 3

   Antenna 1 geniculate between peduncular segments 1 and 2, segment 1 much longer than 2 and 3 combined; peraeopod 3 doubly geniculate; uropod 3, outer ramus more than twice the peduncle, terminal segment conspicuous 5

3. Body slender, pleosome smooth or hirsute dorsally; eyes well pigmented; accessory flagellum 2-segmented; coxal plates 1–4 normal; gnathopods 1 and 2 subchelate, dissimilar . . . . **Pontoporeia.** 4

   Body broad, pleosome segments 2 and 3 (occ. 1) mid-dorsally toothed; eyes lacking; accessory flagellum 3–4 segmented; gnathopods 1 and 2 subchelate similar . . . . **Priscillina**

Peraeopods 3 and 4, segment 2 with posteroproximal spinous process; only one North Atlantic species known . . . . **Priscillina armata** (Boeck)

4. Urosome segment 1 with mid-dorsal bifid prominence; anterolateral head lobe sharply acute; eyes large, reniform . **Pontoporeia femorata** Krøyer

Urosome segment 1 dorsally smooth, finely pilose; anterior head lobe subacute; eyes small, subovate . . . . . . **Pontoporeia affinis** Lindstrom

5. Gnathopod 2 weakly subchelate; maxilliped palp, segment 3 short, broad; uropod 3, inner ramus slender, longer than peduncle; telson incompletely cleft . . . . **Amphiporeia.** 6

Gnathopod 2 subfusiform, heavily setose; maxilliped palp, segment 3 slender, strongly arched; uropod 3, inner ramus lobate, shorter than peduncle; telson typically cleft to base . . . . **Bathyporeia**

Urosome segment 1 with dorsal and lateral spines.
Bathyporeia quoddyensis Shoemaker (p. 171)

6. Antenna 1 weakly geniculate; abdominal side plate 3 subquadrate, posterior margin gently convex; uropod 3 elongate, inner ramus and terminal segment of outer ramus subequal . . . **Amphiporeia virginiana** Shoemaker

Antenna 1 sharply geniculate; abdominal side plate 3 subacute, posterior margin shallow-concave; uropod 3 medium-long, inner ramus much longer than terminal segment of outer ramus.
Amphiporeia lawrenciana Shoemaker

7. Peraeopod 2 distinctly smaller than and unlike peraeopod 1; coxal plates 1 and 2 much smaller than 3 and 4; telson of two widely separated lobes.
Eohaustorius (American Pacific)

Peraeopods 1 and 2 subequal, similar; coxal plates 1 and 2 appreciably deep and broad; telson entire or variously cleft, lobes approximate . . . 8

8. Posterodorsal border of pleon segment 3 free or slightly decurved, not reflexed; urosome and uropod 1 strong, rami spinose; pleon side plate 3 rounded 9

Posterodorsal border of pleon segment 3 strongly reflexed forming a lobe overhanging urosome; urosome short; uropod 1 slender, inner ramus with spines and setae; pleon side plate 3 (except in *Haustorius*) with posterior spinous process 15

9. Body relatively slender, lateral lobes of peraeon weak; pleon gradually narrowing behind; head not broadened, rostrum weak; maxilliped palp 3rd segment not geniculate; maxilla 2, outer plate little larger than inner . . . . **Protohaustorius,** new genus. 10

Body broadly arched, peraeon lobes pronounced; abdomen abruptly narrowing beyond peraeon 7; head very broad, rostrum distinct; maxilliped palp terminal segment geniculate; maxilla 2 with large, setose, outer plate . 11

10. Coxal plate of peraeopod 2 much broader than deep, elongate behind; peraeopod 5, posterior border of segment 4 narrower than anterior border, with two spine groups; uropod 1, posterior margin of peduncle distally spinose . . . . **Protohaustorius deichmannae,** new species (p. 173)

Coxal plate of peraeopod 2 little broader than deep; peraeopod 5, posterior margin of segment 4 wider than anterior, with 3–4 spines; uropod 1, posterior margin of peduncle spinose throughout.
Protohaustorius wigleyi, new species (p. 175)

11. Uropod 2 strong, biramous; telson broad, sharply or broadly cleft; antenna 2, peduncular segment 5 broad but not lobate behind; mandible with incisor.
Parahaustorius, new genus. 12

Uropod 2 small, uniramous, spatulate; telson small, entire; antenna 2, peduncular segment 5 lobate behind; mandible without incisor.
Neohaustorius, new genus. 14

12. Peraeopod 5, coxal plate broadly acute or rounded behind, segment 6 about equal to segment 5; uropod 1, posterior margin of peduncle spinose throughout; telson narrowly V-cleft, lobes rounded 13

Peraeopod 5, posterior lobe of coxal plate sharply elongated, segment 6 markedly longer than segment 5; uropod 1, posterior margin of peduncle centrally unarmed; telson very broad, shallowly V-cleft.
Parahaustorius attenuatus, new species (p. 182)

13. Peraeopod 5, segment 4 subrectangular, posterior margin subtruncate, with two (or three) prominent spines; peraeopod 4, segment 6 not longer than segment 5; uropod 1, inter-ramal spines less than half inner ramus.
Parahaustorius holmesi, new species (p. 180)

Peraeopod 5, segment 4 narrowing behind, posterior margin oblique, with one spine; peraeopod 4, segment 6 longer than segment 5; uropod 1, inter-ramal spines more than half length of inner ramus.
Parahaustorius longimerus, new species (p. 178)

14. Antenna 2, flagellum abruptly narrowing beyond segment 1; uropod 1 uniramous; maxilla 2, outer plate semilunate.
Neohaustorius schmitzi, new species (p. 188)

Antennae 2, flagellum gradually narrowing; uropod 1 unequally biramous, inner shorter (occasionally lacking); maxilla 2, outer plate broad, apically rounded . . . . . **Neohaustorius biarticulatus,** new species (p. 186)

15. Head broadest posteriorly, lateral margins subparallel, rostrum short; uropod 1, rami distally expanding, inner ramus the longer; uropod 3, terminal segment of outer ramus small or vestigial; maxilla 2, outer plate little larger than inner, weakly plumose; telson shallow-cleft, slender-setose.
Pseudohaustorius, new genus. 16

Head broadest medially, lateral margins convex, rostrum strong; uropod 1, rami distally tapering, outer ramus usually the longer; uropod 3, terminal segment of outer ramus normal, distinct; maxilla 2, outer plate very large, plumose; telson sharply cleft, short-spinose 18

16. Peraeopod 5, coxal lobe not exceptionally elongate; hindlobes of segments 4 and 5 lacking a distinct posterior border; hindmargin of telson nearly straight . . . . . . **Pseudohaustorius borealis,** new species (p. 193)

Peraeopod 5, posterior coxal lobe large and elongate; hindlobes of segments 4 and 5 with distinct posterior border, each with two spine groups; telson broadly V-cleft 17

17. Antenna 1, peduncular segment 3 longer than first three flagellar segments; peraeopod 3, segment 6 shorter than width of segment 5; uropod 3, outer ramus distinctly 2-segmented.
Pseudohaustorius caroliniensis, new species (p. 191)

Antenna 1, peduncular segment 3 shorter than first two flagellar segments; peraeopod 3, segment 6 longer than width of segment 5; uropod 3, outer ramus appearing 1-segmented.
Pseudohaustorius americanus (Pearse)

18. Pleon side plate 3 rounded behind; uropod 1, rami subequal; urosome 2, dorsal margin short, nearly occluded; rostrum and anterolateral angles acute . . . . **Haustorius** Müller. 19

Pleon side plate 3 with posterior spinous process; uropod 1, inner ramus shorter, usually more slender than outer; urosome 2 dorsal margin about equal to that of urosome 3; rostrum and anterolateral angles broad-acute.
Acanthohaustorius, new genus. 20

19. Peraeopod 5, posterior margin of segment 4 armed with 3–4 groups of spines; uropod 1, concave posterior margin lined throughout with spines, outer ramus with posterior spines only; rostrum extending slightly anterior of lateral angles (European-Atlantic only).
Haustorius arenarius (Slabber)

Peraeopod 5, posterior margin of segment 4 with one group of spines only; uropod 1, posterior marginal spines concentrated proximally and distally, both rami with spines and long setae; rostrum variable in length, may reach half length of antennal peduncular segment 1.
Haustorius canadensis Bousfield (p. 197)

20. Telson cleft nearly to base, posteromedial margins broadly convex; peraeopod 4, distal margin of segment 5 subtruncate; uropod 1, inner ramus slender, setae singly inserted; mature animals small (4–12 mm.) 21

Telson sharply U-cleft, ½ to base, lobes subtruncate behind; peraeopod 4, distal margin of segment 5 oblique; uropod 1, inner ramus strong, posterior marginal setae in clusters; animals medium-large (10–14 mm.)
Acanthohaustorius spinosus (Bousfield) (p. 204)

21. Pleosome 3, posterodorsal margin produced as a large subconial process, side plate with short weak spinous process; peraeopod 5, coxal plate posteriorly quadrate, posterior lobe of segment 4 short, posterior and proximal margins continuous, with 1 spine.
Acanthohaustorius intermedius, new species (p. 202)

Pleosome 3, posterodorsal margin normally rounded behind, side plate with large spinous process; peraeopod 5, coxal plate posteriorly acute, hindlobe of segment 4 elongate, posterior margin distinct, with 2 spines . . . 22

22. Uropod 1, inner ramus very slender and short, about ½ length of outer ramus; peduncle strongly spinose posteriorly; gnathopod 1, segment 5 slightly inflated; telson broad, lobes broader than long.
Acanthohaustorius shoemakeri, new species (p. 204)

Uropod 1, inner ramus nearly equal in length to outer ramus, peduncle with few posterior marginal spines; gnathopod 1, segment 5 strongly inflated, powerful; telson lobes as broad as long.
Acanthohaustorius millsi, new species (p. 199)

Subfamily Pontoporeiinae

Genus *Bathyporeia* Lindstrom

Bathyporeia quoddyensis Shoemaker 1949

Material examined.—Woods Hole, Mass., near Nobska Pt., sandy beach below low water, Aug. 16, 1959, E. L. Mills.: 1 ♀, ov., 5.0 mm., 1 imm. (NMC 7080); east side Nobska Pt., fine sand at low water, July 28, 1962, E. L. Mills.: 1 ♂, 5.0 mm.; 1 ♀ ov., 4.0 mm. (NMC 7081).

Cape Cod region, Mass., Meganset, at breakwater, fine sand, low water, Sept. 2, 1963: 2 ♂♂, 5 ♀♀; Little Sippewisset Marsh, beach at mouth, low water, Sept. 8, 1963: 1 ♂, 21 ♀♀; Wild Harbor,

south side, fine sand, low water, Sept. 15, 1963: 40 ♀♀; North Falmouth, Herring Brook, fine sand at mouth, low water: 1 imm.; off Nashawena Island, Quick's Hole, sand, 45 ft. grab, Sept. 18, 1963: 2 imm. (MBL, author collections).

Northern New England, 1963: more than 700 specimens obtained at 8 suitable collecting stations from East Sandwich, Mass., north to Saco Bay and Hermit Island, Maine; additional 200 specimens collected at Gosses Cocques and Salmon River beaches near the mouth of St. Mary Bay, western Nova Scotia (NMC, author collections).

Remarks.—Material from Woods Hole differs somewhat from the type material of Shoemaker (1949) from East Quoddy, Maine, in having a more pronounced and sharply undercut posterior basal lobe in peraeopod 5. Also, the dorsal spines of urosome 1 are more numerous, especially in the male. The male (penultimate stage) surprisingly is little different from the female. Antennal flagella are somewhat longer, 5–6 segmented, calceolate in antenna 2. Basal peduncular segment of antenna 1 is without the protuberance on the under surface. Pleon side plate 3 is weakly mucronate behind, but the posterior margin is more broadly convex.

The large peduncular first segment of left and right antenna 1 are approximated closely and taper distally to form a pseudorostrum, shielding the distal portion of the antenna much as in the Phoxocephalidae.

Subfamily Haustoriinae

Protohaustorius, new genus

Head normal, broadening somewhat posteriorly; rostrum short, antennal sinus shallow. Body relatively slender, lateral lobes of peraeon very short. Pleosome narrowing gradually behind peraeon 7, hindmargin slightly decurved but not reflexed nor overhanging side plates, rounded behind urosome. Urosome strong, with well-developed posteroventral lappet on segment 1, urosome 2 short, narrow. Antenna 1 semigeniculate, peduncular segment 1 enlarged, closely approximating its mate (as in *Bathyporeia*), segments 2 and 3 slender; flagellum calceolate in both sexes, accessory flagellum 2-segmented. Antenna 2, peduncular segments 4 and 5 elongate, 4 weakly lobate behind.

Upper lip apically rounded. Lower lip: inner lobes simple, distally rounded. Mandible: incisor and lacinia unicuspate, accessory blades few, palp large, comb row short. Maxilla 1: palp short, plumose; accessory lobe vestigial. Maxilla 2: outer plate small. Maxilliped: plates short, palp segment 3 not geniculate.

Gnathopods 1 and 2 slender, coxal plates distally broadest. Gnathopod 2: segment 6 short, tumid, thickly setose. Peraeopods 1 and 2 slender fossorial, coxa of 2 very broad. Peraeopods 3–5: segments 4 and 5 little expanded, marginal spines elongate. Peraeopod 3 about ⅔ peraeopod 5. Brood plate vestigial on peraeon 3. Pleopods: rami 10–14 segmented, outer ramus slightly longer. Uropods biramous. Uropod 1 strong; rami long, spinose, inter-ramal spines large; uropod 2 small, peduncle short. Uropod 3 longer, rami slender. Telson subquadrate, apically notched, sparsely spinose.

TYPE SPECIES.—*Protohaustorius deichmannae*, new species.

ADDITIONAL SPECIES.—*Protohaustorius wigleyi*, new species.

Protohaustorius deichmannae, new species

FIGURES 1*k*, 2*c*, 4*k*, 6, 7

MATERIAL EXAMINED.—Cape Cod, Mass., Barnstable Harbor, beside west channel, sandy mud, low water, May 13, 1962, E. L. Mills, E. Deichmann, E. L. Bousfield: 3 ♂♂, 2 ♀♀, ov. (NMC 7032); sandy bar opposite town wharf, May 13, 1962, E. L. Bousfield: 1 ♀, holotype, 1 ♂, allotype (NMC 7030); same locality: 9 ♀♀, 6 ov., 18 ♂♂, 1 imm. (NMC 7031); near Nobska Point, sandy beach below low water, Aug. 16, 1959, E. L. Mills: 1 imm. (NMC 7033). Woods Hole, Mass., east end of Nobska Beach, low water, Aug 26, 1961, E. L. Mills: 2 ♀♀, 1 ov. (NMC 7034); east side of Nobska Point, fine sand at low water, July 28, 1962, E. L. Mills: 5 ♀♀, ov., 1 ♂, 10 imm. (NMC 7035).

Cape Cod region, Nobska Beach, fine sand, low water, Sept. 1, 1963: many specimens; Nobscussett Beach, at breakwater, low water, Sept. 9, 1963: 50+ specimens (MBL, author collections). Northern New England, 1963: more than 1800 specimens obtained at 11 suitable stations from East Sandwich and Cape Cod Canal, north to Prout's Neck, Saco Bay, Maine (NMC, author collections).

DESCRIPTION.—Female, 4.0–6.0 mm. Head a little longer than wide, eyes slit shaped, weakly pigmented, remote from shallow antennal sinus. Antenna 1: peduncular segment 2 subcylindrical, short; flagellum 5-segmented. Antenna 2: peduncular segment 4 medially broadest; flagellum 4-segmented, 1st segment much broader.

Upper lip: apex smooth. Lower lip: inner lobes apically rounded. Mandible with 3 accessory blades; terminal segment of palp with 4 comb spines and about 10 slender apical spines. Maxilla 1: inner plate with 5 marginal setae. Maxilla 2: outer plate with 10 pectinate and 2 plumose inner marginal setae. Maxilliped palp: segment 3 short clavate.

Gnathopod 1: coxa with 2 plumes at posterior angle; segment 3 short, 6 slender, dactyl with stout apical nail. Gnathopod 2: segment 2 anterior margin sinuous, segment 5 elongate, a few slender comb spines ventrodistally; segment 6 short, tumid. Peraeopod 1: coxa with single large seta at posterior angle; segment 4 slightly expanded, anterior margin bare; segment 6 small, with about 12 slender marginal spines. Paraeopod 2: posterior lobe large, acute, lower margin long, gently convex; segment 4 stout, anterior margin bare; segment 6 subovate, with about 20 slender marginal spines. Peraeopod 3: coxal lobes deep, broad, subequal, margins bare; segment 2 very broad proximally, posterior margin smooth; segment 4 sharply expanding distally, wider than subquadrate segment 5; segment 6 slender, slightly longer than segment 5. Peraeopod 4: posterior coxal lobe shallow, upper margin gently angled; segment 2 broadest proximally, smooth behind; segment 4 subtriangular, broadest distally, 2 rows of facial setae; segment 5 narrowing distally to short, nearly straight dental margin; segment 6 cylindrical, distinctly shorter than 5. Peraeopod 5 coxal plate shallow, posterior lobe short, blunt, segment 2 broad elliptical, posterior margin bare, sharply incised proximally; segment 4; posterior lobe narrowing, hindmargin oblique, with 2 spine groups; segment 5 narrow, posterior margin with 1 spine group; segment 6 narrowly spatulate, about equal to segment 5, terminal spines slender. Anterior coxal gills slender, posterior, short, saclike. Anterior 3 brood plates slender, with 20–30 marginal setae, that of peraeon 3 orbicular, vestigial.

Pleosome side plate 3 rounded behind, anteroventral margin nearly straight; 3 groups of marginal setae and a few isolated lateral facial setae. Pleopods with short strong rami, outer 12–14 segmented, inner about 10-segmented. Uropod 1: peduncle strong, posterior margin with proximal minute serrations and distal row of spines; inter-ramal spines slender; rami long and subequal, outer with 7 posterior spines and distal circlet of about 16 spines; inner with 4 single marginal spines and 10 terminal spines. Uropod 2: outer ramus slightly shorter than inner, both setose apically, peduncle with simple setae only. Uropod 3: rami longer than stout peduncle; terminal segment of outer ramus short, apices with long setae. Telson short with shallow apical V-cleft, lobes each with 5–6 slender marginal spines.

Male, 3.5–4.0 mm.: Smaller but similar to female. Antenna 1: flagellum 4–5 segmented, elongate calceoli on 1–4. Antennae 2 lacking calceoli.

Remarks.—*P. deichmannae* occurs mainly subtidally in shallow, semiprotected inshore water and estuaries, whereas the larger *P.*

wigleyi is a deeper water offshore form, only occasionally found inshore, sometimes in company with *P. deichmannae.*

The species is named in honor of Dr. Elisabeth Deichmann, who assisted in the discovery of the species and who has contributed greatly to knowledge of marine bottom invertebrates.

Protohaustorius wigleyi, new species

Figures 1*l*, 2*b*, 4*l*, 8, 9

Material examined.—*Albatross*-101, sta. 89, 41°29′, 67°28′, Digby bag, 27 fms., Aug. 24, 1957: 1 ♀, holotype, 1 ♂, allotype (NMC 7036); same locality: 3 ♀♀, ov., 6 ♂, 3 imm., paratypes (NMC 7037); same locality, Smith grab: 1 ♀, ov., 2 ♂♂, 4 imm. (NMC 7040). *Albatross*-70, coll. 5, 40°51′, 68°20′, Digby bag, 25 fms., Dec. 7, 1955: 7 ♀♀, 10 ♂♂, 9 imm. (NMC 7038). *Albatross*-70, coll. 15, 41°38′, 67°57′, Digby bag, 11 fms., Dec. 9, 1955: 12 specimens, including ov. ♀♀ (NMC 7039). *Albatross*-101, sta. 86, 41°14′, 67°28′, Smith grab, 24 fms., Aug. 24, 1957: 3 imm. (NMC 7041). *Albatross*-101, sta. 109, 42°02′, 66°58′, Smith grab, 35 fms., Aug. 25, 1957: 1 imm. (NMC 7042).

Albatross-69, coll. 1, 41°52′, 69°59′, Van Veen grab, Nov. 15, 1955: 65 specimens; same locality, Digby grab: 6 adult specimens; *Albatross*-69, coll. 5, 40°33′, 68°57′, Van Veen grab, Nov. 16, 1955: 19 specimens; *Albatross*-70, coll. 8, 41°07′, 67°17′ Digby bag, Dec. 8, 1955: 27 ♀♀; *Albatross*-70, coll. 46, 41°06′, 67°38′, *Albatross*-70, coll. 1, 40°50′, 69°39′, Digby bag, Dec. 6, 1955: 28 specimens (USFW, R. L. Wigley collection).

Albatross-100, sta. 108, 42°08′, 67°04′, Smith grab, Aug. 25, 1957: 1 ♂. Series of *Albatross*-101, Smith grab, Aug. 22–29, 1957, sta. 26, 40°33′, 69°06′: 6 subadults; sta. 38, 40°34′, 68°51′: 1 specimen; sta. 69, 41°02′, 67°56′: 8 ♀♀; sta. 70, 40°57′, 67°52′: 10 adults; sta. 72, 40°49′, 67°49′: 2 adults; sta. 85, 41°09′, 67°29′: 4 adults; sta. 184, 40°48′, 68°06′: 12 adults; sta. 192, 40°48′, 69°02′: 2 subadults; sta. 186, 40°48′, 68°19′, Smith grab, 31 fms., Aug. 28, 1957: 10 ♀♀, ov., 2 ♂♂ (NMC 7043).

Cape Cod region, Nobscussett breakwater, sand, low water, Sept. 9, 1963: 4 specimens; off Nashawena Island, Quick's Hole, SE. entrance, sand, 45 ft. grab, Sept. 18, 1963: 20 adults, 7 imm.; Vineyard Sound, Deep Hole, sand, 100+ ft., Sept. 18, 1963: 1 imm. (MBL, author collection); East Sandwich, Mass., sand, low-water level, Aug. 11, 1963: 33 specimens (NMC, author collection).

Description.—Female 5.5–7.5 mm. Head as long as broad, rostrum broad, obtuse; eyes small, slitlike, removed from margin of shallow antennal sinus. Antenna 1: peduncular segment 1 long and

deep; segment 2 long, distally broadest; segment 3 short, bearing calceolate 5-segmented flagellum terminally and 2-segmented accessory flagellum subterminally. Antenna 2: lobe of peduncular segment 4 diverging distally, segment 5 slender; flagellum of 4 segments, 1st not markedly wider.

Upper lip with slightly bi-indented apex. Lower lip: inner lobes distally broad. Mandibular lacinia and incisor unicuspate; 3 serrated accessory blades; palp segment 3 with 10 short proximal comb spines and 11 slender apical spines. Maxilla 1: inner plate small, 8 slender, simple marginal setae; accessory lobe vestigial. Maxilla 2: outer plate rounding distally, inner margin with about 12 stiff setae proximally and 4 plumes distally. Maxilliped: palp segment 2 broad lobate distally; segment 3 arched, widest distally.

Gnathopod 1: posterior angle of coxa with 5 plumose setae; segment 5 slender, about ⅔ segment 2; segment 6 strong, slightly shorter, dactyl short, nail terminal. Gnathopod 2: posterior angle of coxa with 7 plumose setae; segment 2 sinuous, elongate; segment 5 with 4–5 clusters of slender comb spines ventrodistally; segment 6 tumid, slightly arched.

Peraeopod 1 posterior coxal angle acute, concave posterior margin with 7 plumes; segment 4 slender, anterior margin bare; segment 5: posterior lobe with about 10 slender spines and 6 plumose setae; segment 6 with 15 slender spines. Peraeopod 2: coxal plate produced posteriorly to subacute lobe, lower margin slightly convex; segment 4 strong, stout; anterior margin bare; segment 5 shallow behind, circlet of 8 spines; segment 6 with 14 marginal spines.

Peraeopod 3: posterior coxal lobe large and deep; segment 2 narrowing distally; posterior margin bare; segment 4 not broader than segment 5; segment 6 linear, marginal spines elongate. Peraeopod 4: posterior coxal lobe large, sparsely spinose below; segment 2 posteriorly nearly bare; segment 4 expanded behind a margin convex, spines slender; segment 5 subrectangular, distal margin with pronounced U-shaped incision; segment 6 slender, nearly as long as segment 5. Peraeopod 5: coxal plate rounded behind, margin with a few stout spines; segment 2 extremely broad, posterior margin nearly smooth, not proximally incised; segment 4 subrectangular, posterior margin broad, nearly truncate, with 3–4 stout spines; segment 5 narrow, posterior margin with 1 spine group; segment 6 broadest proximally, length about equal to segment 5; marginal spines long and numerous. Coxal gills slender, smallest posteriorly. Anterior 3 brood plates slender, 4th a minute lobe.

Pleosome side plate 3: entire margin smoothly rounded; lateral face with scattered clusters and singly inserted plumes. Pleopods: outer rami 14–17 segmented, inner 10-segmented. Uropod 1: peduncle

lined throughout posteriorly with stout spines and minute serrations, with a small proximal cluster of stiff setae; 3 stout inter-ramal spines; outer ramus with about 10 posterior spines and inner ramus with about 4. Uropod 2: rami slender, setose apically, about equal to stout peduncle. Uropod 3: rami slender with long apical spines; terminal segment of outer ramus nearly equal to peduncle. Telson with shallow, sharp V-cleft, lobes each with 5 unequal apical spines.

Male, 5.0–6.5 mm.: Similar but smaller than female. Antennae 2 noncalceolate.

Remarks.—*Protohaustorius wigleyi* occurs generally throughout the Georges Bank region, from the northeast slope and Cape Cod Bay southwards, from the shore line to more than 30 fathoms in depth.

Parahaustorius, new genus

Medium to large animals; head short, broadest posteriorly; rostrum strong, acute; antennal sinus deep. Body broad, lateral lobes of peraeon well developed. Pleosome abruptly narrowing behind peraeon 7, segment 2 broadest, hindmargin of 3 segment free, not decurved nor reflexed; side plates rounded behind. Urosome moderately strong, not overhung by pleosome; posteroventral lappet moderately developed; urosome 2 very short and much narrower than urosome 1.

Antenna 1: peduncular segments short and deep, anterior marginal setae simple; flagellum relatively long, accessory flagellum 2-segmented. Antenna 2: peduncular segment 4 broadly lobate, segment 5 stout; flagellum long, segments small.

Coxal plates 1–3 semilunate, distally narrowing and subacute; 4 not produced behind in subacute lobe. Gnathopod 1 powerful, dactyl simple. Gnathopod 2: segment 5 lacking ventrodistal pectinate spines; segment 6 not tumid. Peraeopod 1: segment 5 deeply lobate. Peraeopod 2: segment 5 short, narrow, segment 6 with marginal spines and plumes. Peraeopod 3 relatively small, barely half as long as peraeopod 4 and 5, which are exceptionally large and powerful. Peraeopods 3–5: segment 4 and 5 broad, surfaces richly spinose and setose. Peraeopod 4: segment 4 (merus) elongate, segment 6 slender, sublinear. Peraeopod 5: segment 5 with long posterior margin. Coxal gills large, slightly smaller posteriorly. Brood plates of peraeon 2–4 large, broad, that of peraeon 5 short, slender; marginal setae numerous, short, slender.

Pleopods strong, rami slender, outer 18–24 segmented, inner about 15-segmented. Pleon side plate 3 rounded posteriorly, with marginal cluster of plumes only. Uropods biramous. Uropod 1 very strong; peduncle stout, posterior margin spinose, inter-ramal spines very large; rami unequal, inner shorter, spinose behind. Uropod 2 and 3 sub-

equal, elongate, rami slender. Uropod 3: terminal segment of outer ramus long. Telson broad, apically incised, marginal spines slender, clustered laterally.

TYPE SPECIES.—*Protohaustorius longimerus,* new species.

ADDITIONAL SPECIES.—*P. holmesi,* new species, *P. attenuatus,* new species.

Parahaustorius longimerus, new species

FIGURES 1*f*, 3*a*, 4*d*, 10, 11

MATERIAL EXAMINED.—Cape Cod, Mass., Barnstable Harbor, end of Beach Point, sand flat at low water, Aug. 31, 1959, E. L. Mills: 1 ♂, holotype (NMC 7071); Beach Point, coarse sand, low water, 12°C., May 19, 1962, E. L. Mills: 2 ♀♀, ov., 6 ♂♂, 3 imm., paratypes (NMC 7072); near Nobska Point, sandy beach below low water, Aug. 16, 1959, E. L. Mills: 13 ♂♂, 4 ♀♀, ov., 16 imm. (NMC 7073). Woods Hole, Mass., east end of Nobska Beach, fine sand at low water, Aug. 26, 1961, E. L. Mills: 30 specimens, imm. (NMC 7074); east side of Nobska Point, fine sand at low water, July 28, 1962, E. L. Mills; 1 ♀, ov., 2 imm. (NMC 7075). *Albatross*-101, coll. 15, 41°38′, 67°57′, Digby bag, 11 fms., Dec. 9, 1955: 1 ♀, ov. (NMC 7076). Smith's Island, Va., Ocean Beach, low-water zone, July 5, 1935, J. P. E. Morrison: 11 imm. specimens (USNM acc. 135197); same locality, 100 yds. north of southern tip of Ocean Beach, July 6, 1935, J. P. E. Morrison: 11 imm.; same locality, 200 yds. north of south tip of Ocean Beach, July 6, 1935, J. P. E. Morrison: 1 imm.

Nobska Beach, east end, fine sand, low water, Sept. 1, 1963: many specimens; Nobscusset Beach, at breakwater, sand at low water, Sept. 9, 1963: 100+ specimens; Naragansett Beach at mouth of Pattaquamsett Inlet, R.I., surf sand, low water, Sept. 23, 1963: 6 imm. (MBL, author collections).

Albatross-69, coll. 1, 40°52′, 69°59′, Nov. 15, 1955: 37 adults; *Albatross*-70, coll. 15, 41°38′, 67°57′, Digby bag, Dec. 9, 1955: 4 adults; *Albatross*-101, sta. 68, 41°06′, 68°00′, Smith grab, Aug. 24, 1957: 5 adults (USFW, R. L. Wigley collections).

DESCRIPTION.—Male, 9.5 mm. Head width about twice the length, rostrum broad, blunt conical; eyes small, ellipsoid, weakly pigmented, persisting in adult stage. Antenna 1: flagellum of 9 subequal segments, calceoli slender, 1½ times length of each segment; accessory segments slender, subequal. Antenna 2: anterior marginal setae of peduncular segment 4 short, surface sensory setae few and small; flagellum of 9–10 small segments, shortest proximally and bearing posterior plumose setae.

Upper lip very broad, apically rounding and smooth. Lower lip: inner lobes moderately long, apex broad, subtruncate. Mandibular incisor simple, lacinia small, unicuspate; accessory blades about 10. Palp long, slender, comb row of about 30 short spines, apex with 10 slender spines. Maxilla 1: inner lobe small, margin with about 15 forked setae; palp broadest at apex, with simple and plumose setae, accessory lobe large. Maxilla 2: outer lobe with short inner margin, proximally armed with about 16 pectinate spines and distally with about 25 plumose setae. Maxilliped: outer plate relatively narrow, palp narrow, distal lobe of segment 2 nearly attaining transverse margin of short geniculate segment 3.

Gnathopod 1: posterior coxal angle acute, margin with 6 plumose setae; segment 5 elongate, lower margin heavily setose; segment 6 slender, slightly arched; dactyl small, nail short, apical. Gnathopod 2: posterior coxal angle with 8–10 plumose setae; segment 2 long and slender; segment 5 nearly equal in length, narrow, posterior margin richly setose; segment 6 very slender and moderately arched, dactyl minute.

Peraeopod 1: coxa lunate, posteriorly setose; segment 2 powerful, plumose behind; segment 4 broadening distally, margins lightly setose; segment 6: broad posterior lobe armed with circlet of 12 short slender spines and 10–12 plumose setae; margin of spatulate segment 6 with about 18 slender spines. Peraeopod 2: coxa somewhat broader than deep, shallow sinus weakly setose; segment 2 short, stout; segment 4 powerful, margins convex; segment 6 short and deep, lobe circlet with 8 spines and 6 setae; segment 6 oval, nearly ringed with slender spines and a few plumes proximally. Peraeopod 3: coxal lobes shallow, subequal, segment 2 much broader than deep, sparsely setose behind; segment 4 broad, posterior margin truncate with about 5 spines and numerous long plumose setae; segment 5 narrower; segment 6 linear with 5 anterior spine clusters. Peraeopod 4: posterior coxal lobe deep, lightly setose; segment 2 slightly expanded, narrowing distally; segment 4 very long, margins subparallel, 4 rows of facial spine clusters; segment 5 longer than wide, anterior margin narrowing distally; segment 6 about equal to 5, slender, with 4 posterior spine clusters. Peraeopod 5: coxa with squarish posterior lobe; segment 2 very broad and orbicular, posterior margin bare; segment 5 subrectangular, posterior margin sharply truncate, with 2 heavy spines; segment 5 distally broadest, posterior margin very short, with 1 spine group; segment 6 nearly as long and quite broad, 5–6 spine clusters on each margin. Coxal gill of gnathopod 2 much the largest.

Pleosome side plate 3 shallowly convex, rounded behind, with 7 lateral clusters of setae. Pleopods: peduncle very broad and short, rami slender, inner 15-segmented, outer much longer and 24 segmented

Uropod 1: peduncle and rami subequal, slender, strongly spinose posteriorly; peduncle with proximal raised cluster of stout spines and long setae. Uropod 2: peduncle and rami subequal, with numerous slender simple setae. Uropod 3: rami slender, tapering distally; outer ramus longer, terminal segment much the shorter; peduncle short. Telson cleft narrowly, half way to base; lobes apically bare and smoothly rounding, about 5 lateral groups of short slender spines on each side.

Female, 7–10 mm.: Similar to and slightly larger than male. Telson similar but apparently with fewer lateral spines. Brood plate of gnathopod 2 about as long as segment 2, margins multisetose; that of peraeopod 3 short, slender, margins with 8–10 short setae.

Remarks.—The species is very common along surf-exposed or semiprotected sandy coastlines and offshore banks, ranging from the southwestern shore of Cape Cod Bay, southward to Georgia and northern Florida. The animal may burrow to a depth of 4 inches or more in the sand near low-water level.

***Parahaustorius holmesi*, new species**

Figures 1*h*, 3*b*, 4*f*, 12, 13

Haustorius arenarius.—Holmes, 1904, p. 476–477 (part), fig. p. 476 (not plate V, fig. 2).

Material examined.—New Jersey, off New England Creek, March 20, 1930, H. G. Richards: 1 ♂, holotype (USNM acc. 110360). Vineyard Sound, Mass. Quick's Hole, 109–110 ft. 1871, U.S. Fish Comm.: 1 ♀, ov., allotype (YPM no. 5626). Woods Hole, Mass., 1904–5 [no other data]: 1 ♀, ov. (USNM acc. 66504). *Albatross*-101, sta. 88, 41°24′, 67°28′, Smith grab, 18 fms., Aug. 24, 1947: 3 imm. (NMC 7066). *Albatross*-101, sta. 89, 41°29′, 67°28′, Smith grab, 27 fms., Aug. 24, 1957: 1 imm. (NMC 7067).

Albatross-101, sta. 90, 41°34′, 67°28′, Smith grab, Aug. 24, 1957: 1 ♀, ov.; *Delaware*-59–9, sta. 19, 41°43′, 68°05′, Smith grab, Aug. 6, 1959: 1 adult. (USFW, R. L. Wigley collections).

Description.—Male, 10.0 mm. Head broad and deep, rostrum strong. Eyes lacking in adults, small round weakly pigmented areas near anterolateral angles in immatures. Antenna 1: peduncular segment 1, proximal lateral setae weakly plumose or simple segment 2 subequal, broadening distally, anterior marginal setae long, weakly plumose; segment 3 short, broad; flagellum of 9 short segments, distally longest, accessory flagellum of 2 slender subequal segments, combined length nearly half the flagellum proper. Antenna 2: peduncular segment 4 slightly deeper than long, surface sensory setae in 2 rows of 5; segment 5 tunid, anterior setae long, weakly plumose;

flagellum of 11 segments, proximal 4 shortest, each with plumose seta behind.

Upper lip squarish, apical margin nearly straight, smooth. Lower lip: outer lobes heavily pilose distally, inner lobes rather slender, proximally acute. Mandible: incisor bicuspate on left, tricuspate on right side, bicuspate lacinia on right, lacking on left, accessory blades 9–10; palp moderate, segment 3 shorter than 2, comb row with 20 stiff spines; 10–11 slender apical spines. Maxilla 1: inner plate small, margin with 11 branching setae; palp strongly arched, setae nonplumose; accessory lobe small. Maxilla 2: outer plate short, broad, inner margin proximally with about 20 slender spines and distally with 10 plumose setae distally to apex. Maxilliped: inner plate with 10 slender inner marginal blades, outer plate nearly smoothly convex on both sides; palp: narrow apical lobe of segment 2 small; segment 3 sharply geniculate, stem thicker than median lobe.

Gnathopod 1: posterior coxal angle sharply rounded bearing 4 plumose setae; segment 2 arched behind, distally setose; segment 5 nearly as long, expanded and heavily setose behind; segment 6 strong, tumid, distally with long cleft-tipped setae; nail of dactyl strong, apical. Gnathopod 2: coxa similar to 1, angle with 6 plumose setae; segment 2 slender, slightly arched, segment 5 subcylindrical, simple setae behind; segment 6 similar to but slightly longer than in gnathopod 1, dactyl conspicuous.

Peraeopod 1: coxa semilunate, acute posterior angle with 5 plumose setae; segment 2 strong, plumose behind; segment 4 margins plumose; segment 5, deep posterior lobe with circlet of 13 slender spines and 6 long weakly plumose setae; segment 6 broad spatulate, 16 marginal spines. Peraeopod 2, coxa deep, smoothly convex below, posterior sinus long; segment 2 short, sublinear; segment 4 rather broad, margins plumose; segment 5: lobe circlet of 9–10 slender spines and 5 setae; segment 6 drop shaped, 11 with marginal spines and 5 setae. Peraeopod 3: coxal lobes subequal, hindlobe with oblique setose posterior margin; segment 2 very broad, with short setose hindmargin; segment 4 not wider than long, hindmargin with 4 spine groups; segment 5 squarish; segment 6 linear, slender, distinctly longer than 5. Peraeopod 4: coxal hindlobe steeply oblique, margin setose; segment 2: hindmargin setose proximally; segment 4 short and broad, with about 10 posterior spines and 4 facial rows of spine clusters; segment 5 almost square, distal margin truncate; segment 6 nearly as long, slender, with 4 posterior spine groups and terminal clusters. Peraeopod 5: coxal plate broadly acuminate behind, lower border with 4–5 stiff setae; segment 2 much broader than deep, anterior margin proximally with plumose setae, distally with slender spines, posterior margin nearly smooth; segment 4: posterior lobe

long and narrow, hindmargin short, oblique, with 1 spine cluster; segment 5 widest nadially, length of posterior margin more than half the anterior, 2 spine clusters present; segment 6 subequal, slender, wider proximally.

Pleon side plate 3, lower margin evenly and smoothly convex; 7 clusters of lateral plumose setae, 3 to 6 per cluster. Pleopods: peduncles squarish to broad rectangular; outer ramus 19-segmented, slightly longer than 15-segmented inner ramus. Uropod 1: peduncle stout, strongly arched, posterior margin lined with stout spines, proximal protruberance with a very strong spine and a row of 6 stiff setae; 2 stout inter-ramal spines; outer ramus heavier and longer than inner, both terminated in a cluster of long spines, and bordered behind with shorter spines. Uropod 2: rami slender, subequal, setose throughout, longer than peduncle, which is simply setose distally. Uropod 3: rami long and slender, fine spinose terminally, outer ramus distinctly longer than inner, terminal segment about equal to the peduncle. Telson finely cleft halfway to base, lobes smoothly rounding.

Female, 10–13 mm.: Similar to male but larger. Flagellum of antenna 1 without visible calceoli. Brood plate of gnathopod 2 short and broad, that of peraeopods 1 and 2 very large, of peraeopod 3 slender, short, with 10 marginal setae.

Remarks.—Holmes' description (1904, p. 476) and figure of 3rd uropod and telson unquestionably apply to this species. His photographic plate V (fig. 2) is that of the true *Haustorius arenarius* (Slabber) and probably is based on specimens from Devon, England, which he compared with American material. Despite the many differences (several of generic value) which he himself noted, he concluded that the European material was specifically identical with the American form. The size range (up to 18 mm.) considerably exceeds material of *H. holmesi* examined but equals the largest *H. canadensis* at hand. This large distinctive species is named in honor of the man who first described it and who contributed so greatly to North American carcinology at the turn of the century.

This species ranges offshore, usually in depths of 10–20 fathoms, from Georges Bank southwards.

***Parahaustorius attenuatus*, new species**

Figures 1*g*, 3*c*, 4*e*, 14, 15

Material examined.—New Jersey, sta. 156 [no other data]: 1 ♀, holotype, 1♀, paratype (USNM acc. 115760). New York, off Block Island, USFC Sta. 828, 1880: 1 ♀, ov. (USNM acc. 38612).

Vineyard Sound, Mass., Quick's Hole, 109–110 ft., USFC, 1871: 1 ♀ ov. (YPM 5626). *Albatross*-101, sta. 86, 41°14′, 67°28′, Smith grab, 24 fms., Aug. 24, 1957: 1 v. imm. (NMC 7070). *Albatross* sta. 88, 41°24′, 67°28′, Smith grab, 18 fms., Aug. 24, 1957: 1 ♂ (NMC 7068). *Albatross* sta. 89, 41°29′, 67°28′, Smith grab, 27 fms., Aug. 24, 1957: 4 imm. (NMC 7069).

Vineyard Sound, Mass., Quick's Hole, SE. entrance, 45 ft. grab, Sept. 18, 1963: 1 ♂, 2 juv.; Narragansett Beach, near Pattaquamsett Inlet, surf sand, low water, Sept. 23, 1963: 3 adult specimens (MBL, author collections).

Albatross-69, coll. 1, 41°52′, 69°59′, Nov. 15, 1955: 2 ♀♀, 1 imm.; *Albatross*-100, sta. 108, 42°08′, 67°04′, Smith grab, Aug. 25, 1957: 2 imm.; *Albatross*-101 series, sta. 24, 40°43′, 69°04′, Smith grab, Aug. 22–24, 1957: 1 v. imm.; sta. 68, 41°06′, 68°00′: 1 adult, 4 juv.; sta. 69, 41°02′, 67°56′: 1 v. imm.; sta. 60, 40°57′, 67°52′: 1 v. imm. (USFW, R.L. Wigley Collections).

Description.—Female, 10.5–14.0 mm. Head short, very broad, rostrum and lateral angles sharply acute, antennal sinus deep, eyes lacking in adult, small pigmented ellipsoids in juveniles. Pleosome broad, flat, not rounding dorsally. Urosome 1: ventral lappet short. Antenna 1: peduncular segment 1 very short, deep, lateral setae in semicircular arch, plumose distally, simple proximally; segment 2 shorter, expanded distally, anterior setae short, simple; segment 3 very short and broad; accessory flagellum of slender unequal segments combined length greater than first three of 9-segmented flagellum; calceoli apparently lacking. Antenna 2: peduncular segment 4 with very deep, strongly convex posterior lobe, surface sensory setae short; segment 5 tumid, anterior marginal setae (as in 4) very short and fine; flagellum of 10 short segments, first 2 plumose behind.

Upper lip broad rectangular, apex smooth, slightly indented on either side of midline. Lower lip: outer lobes very large, margin unevenly rounding, inner truncate; inner lobes broad, distally, short pilose. Mandible: left incisor tricuspate, right quadridentate; right lacinia subcylindrical short, bicuspate left lacking; 10–13 accessory blades; palp segment 2 somewhat broadened medially, margins sparingly setose; segment 3 shorter and more slender, more than 30 short comb spines, apex with 11 slender spines. Maxilla 1: inner plate very small, margin with 10 distally plumose setae; outer plate broad, about 16 spine teeth, outermost strongest; palp slender and moderately arched, marginal setae numerous; accessory lobe short, broad, semicircular. Maxilla 2 outer plate nearly as broad as long, margins unevenly rounded, inner proximally with about 20 slender blades, distally with only 9 plumes; inner plate long and

slender, facial row gently sinuous. Maxilliped: inner plate small, nearly uniformly narrow, about 10 inner marginal blades, outer plate much longer, broader, and apex blunt rounded; palp segment 2 short and broad, expanding distally; segment 3 strongly geniculate, width exceeding length, apical angle acute.

Gnathopod 1: coxal plate short and semilunate, posterior angle blunt, 7-setose; segment 2 broadened, both margins convex, anterior with a few plumes, posterior with simple setae; segment 5 powerful, upper margin much longer than lower; segment 6 tumid proximally, anterior margin convex; nail of dactyl stout, long. Gnathopod 2 similar, longer, coxa with about 10 posterolateral plumes; segment 2 long, setose behind; segment 6 longer than 5, more slender and strongly arched than in gnathopod 1, dactyl prominent.

Peraeopod 1: coxal plate strongly semilunate, acute angle with about 8 plumes; segment 2 broad, heavily plumose behind; segment 4: margins plumose; segment 5 with deep posterior lobe, broad circlet of 12 short slender spines and 12 plumose setae; segment 6 broad, spatulate, more than 20 marginal spines, innermost longest. Peraeopod 2: coxal plate very deep, smoothly rounding below, posterior lobe very short, segment 2 richly plumose behind; segment 4 expanding distally, margins plumose; segment 5 short, deep, lobe narrow, circlet of 10 spines and 6 setae; segment 6 elliptical, margin with 12 spines and 8 plumes. Peraeopod 3: coxa very broad, hindlobe with steep setose posterior margin; segment 2 suborbicular, margin finely setose proximally; segment 4 broader than deep, lobe rounding behind, margin with 4–5 spine groups; segment 5 equally broad, very short; segment 6 long, tapering, anterior and terminal spines long and slender. Peraeopod 4: posterior coxal lobe large, oblique, margin rounding below, with numerous short setae; segment 2: posterior margin distally bare; segment 4 long and very broad, posterior margin shallowly convex, with about 12 spines, facial spine clusters in 5 rows; segment 5 much narrower, distal margin short, slightly oblique; segment 6 slender, arched and very long, with 5–6 paired groups of posterior spines. Peraeopod 5: coxal plate shallow, attenuated posteriorly in prominent, acutely pointed lobe; segment 2 extremely broad, anterior margin much longer than posterior, which is nearly bare except for proximal short setae; segment 4: posterior lobe narrow, elongate, proximal, and posterior borders merging into virtually continuous oblique margin, one spine group at "angle"; segment 5 broad and deep, posterior margin convex, 2-spinose, nearly as long as anterior margin; segment 6 broad, tapering distally, distinctly longer than segment 5, margins with 7–8 spine clusters. Gills relatively long and slender, largest anteriorly. Brood plates on peraeopods 1 and 2 very large, 40–60 marginal

setae, smaller on gnathopod 2, short and slender and with 8 long marginal setae on peraeopod 3.

Pleon side plate 3 smoothly convex below and rounded behind, with 5 lateral clusters of 5–9 plumose setae and about 4 anterior singly inserted setae. Pleopod 3: 20-segmented outer ramus distinctly longer than 16-segmented inner ramus. Uropod 1: peduncle stout, strongly arched, posterior margin nearly smooth except for proximal hump bearing a large spine and a row of about 12 stiff setae; 2 very large and strong inter-ramal spines, longest nearly ¾ the inner ramus; outer ramus longer and heavier than inner, both with slender posterior marginal and terminal spines. Uropod 2 larger and stouter than 3. Uropod 3: outer ramus somewhat longer than inner, terminal segment shorter than peduncle. Telson very broad, apex with shallow V-cleft, posterolateral angle of each lobe with about 10 slender spines.

Male, 10.5 mm.: Similar to female but smaller. Antenna 1: flagellum without calceoli.

Remarks.—This large species occurs from the shoreline to depths of more than 20 fms., from the northeast slope of Georges Bank southwards to New Jersey. It is taken frequently in the same bottom sample as *P. holmesi*, a remarkable ecological phenomenon considering the close morphological similarity of the two species.

Neohaustorius, new genus

Small haustoriids. Head very short and broad, rostrum weak, inferior antennal sinus present, lateral margins subparallel. Body very broad, arched above, lateral lobes of peraeon long. Pleosome very short and broad, abruptly narrowing behind peraeon 7, hindmargin slightly deflexed, side plates rounded behind. Urosome stout, longer than pleon 3 but not overhung by pleosome, ventral lappet broad, short; urosome 2 as long as 3, narrower than urosome 1.

Antenna 1: peduncular segments short; flagellum with clusters of elongate calceoli in both sexes; accessory flagellum 2-segmented. Antenna 2: peduncular segment 4 and 5 deeply lobate behind; first flagellum segment elongate.

Upper lip broad, smooth. Lower lip: inner lobes elongate, slender. Mandible without incisor, lacinia monocuspate, accessory blades few (3–5); palp stout, comb row short. Maxilla 1: inner plate with bifid setae; accessory lobe moderate. Maxilla 2 broad, elongate, semilunate, inner margin distally plumose; inner plate long, narrow. Maxilliped plates short and broad, palp segment 3 geniculate.

Gnathopods slender, coxal plates small, rounding below. Gnathopod 2: segment 5 with pectinate spine groups. Peraeopods 1 and 2 weakly fossorial, segment 5 with small posterior lobe. Peraeopods

3–5: distal segments slightly expanded, weakly spinose and plumose; peraeopod 3 nearly equal in length to peraeopod 5. Coxal gills largest posteriorly. Brood plates of gnathopod 2 small, narrow, vestigial on peraeopod 3.

Pleopods moderately strong, outer ramus 12–16 segmented, peduncles short. Uropod 1 uniramous or with short inner ramus. Uropod 2 very small, single ramus spatulate. Uropod 3 stout, rami subequal. Telson small, subquadrate, entire.

Type species.—*Neohaustorius schmitzi*, new species.

Additional species.—*Neohaustorius biarticulatus*, new species.

Remarks.—This genus is highly specialized for filter feeding but peraeopods are relatively unspecialized for burrowing. The reduction of uropods is the principal distinguishing feature of this genus.

Neohaustorius biarticulatus, new species

Figures 1*j*, 2*e*, 4*i*, 16, 17

Material examined.—West Falmouth, Mass., Sippewisset Marsh, Feb. 13, 1960, R. L. Wigley: 1 ♀, holotype (NMC 7028). Woods Hole, Mass., east side of Nobska Point, fine sand at low water, July 28, 1962, E. L. Mills: 1 ♀, ov., paratype (NMC 7029).

Cape Cod, Mass., Little Sippewisset Marsh, sand bars near mouth, midwater level, Sept. 8, 1963: 200+ subadult specimens; Great Sippewisset Marsh, sand bars above mouth, midwater level, Sept. 8, 1963: 35 specimens (some ov. ♀♀); Wild Harbor, sand bars near mouth, midwater to low-water levels, Sept. 15, 1963; Herring Brook, sand bars above mouth, midwater level, Sept. 19, 1963, R. L. Wigley: 10 specimens; Old Silver Beach, sand, low water, Feb. 13, 1960: 2 ♀♀; same locality, Jan. 30, 1960: 2 ♀♀ (MBL, author collections).

Note: Two ovigerous females from Herring Brook lack any trace of inner ramus on uropod 1, whereas a small inner ramus is present in the other material.

Description.—Female, 5.0 mm. Head very broad, margins subparallel, rostrum short, anterolateral lobes sharply rounded, flaring outwards. Eyes weakly pigmented. Peraeon lateral lobes well developed. Antenna 1: peduncular segment 1 deep, lateral margin with about 6 heavy plumose setae; segment 2 linear, anterior marginal spines long, cleft tipped; segment 3 short; flagellum 6-segmented; accessory flagellum, outer segment shorter than inner. Antenna 2: posterior lobe of segment 4 deep, broadly arcuate, anterior margins of 4 and 5 with row of simple, stiff setae; flagellum 4-segmented, 1st shorter than 2 and 3 combined.

Upper lip broadly rounded and apically smooth. Lower lip: outer lobes with truncate inner margins, thickly pilose; inner lobes nearly 4 times as long as broad, lightly setose apically. Mandible: lacinia

small, conical; 5 accessory blades; palp short, segment 2 very stout, margins setose; terminal segment subequal, with 8–9 short comb spines and 10–11 slender apical spines. Maxilla 1: inner lobe large, 9 bifid marginal setae; outer lobe small, palp short, apical cluster with simple and plumose setae; accessory lobe large, setae long. Maxilla 2: outer lobe broad lunate, outer margin pilose, inner margin proximally with nearly 20 pectinate slender spines and distally with nearly 30 plumose setae; inner lobe rather broad. Maxilliped: inner plate relatively large, narrowing distally, apex with about 4 slender blades and short prominence with 2 unequal spine teeth; outer lobe with strongly convex outer margin; palp: inner margin of segment 2 convex, segment 3 short, geniculate, medial lobe short.

Gnathopod 1: coxal plate subrectangular, rounding distally, posterior angle with a plumose seta(?); segment 2 rather strongly arched, posterior margin richly setose; segment 5 stout, lower marginal setate simple and cleft tipped; segment 6 shorter, sublinear, marginal setae cleft tipped; dactyl with long stout nail. Gnathopod 2 with 2 plumose setae at squared posterior corner; segment 2 straight, setose behind; segment 4 slightly expanded below (behind), proximally with simple and cleft-tipped setae, distally with about 12 pectinate spines; segment 6 rather short, both margins convex, dactyl small.

Peraeopod 1: coxal plate arcuate, posterodistal angle acute, with 1 long seta; segment 2 stout; segment 4 expanding distally, margins with plumose setae; segment 5 with circlet of 10 lobe spines; segment 6 with 11 marginal spines. Peraeopod 2 smaller and weaker, coxal plate broadly rounding to blunt posterior process; segment 2 short, narrow, setose behind; segment 4 moderately expanded, a few plumose setae anteriorly, simple setae posteriorly; segment 5 and 6 with 4 and 2 long plumose setae on posterior lobes respectively. Peraeopod 3: coxal plate very broad, lobes subequal, margins nearly smooth; segment 2 broadly rounding behind, margin lightly setose; segment 4 expanding distally, subequilateral; segment 5 slightly broader than long, 3 groups of stout facial spines; segment 6 short, cylindrical, terminal spines long. Peraeopod 4: coxal plate with lightly setose posterior lobe; segment 2 broadest distally, posterior margin smooth; segment 4 short, nearly as broad as long, margins heavily plumose, a few short facial spines; segment 5 quadrate; segment 6 short and cylindrical. Peraeopod 5: coxal plate small, rounded behind; segment 2 orbicular, anterior margin with broad plumose blades; segment 4 slightly expanded, no posterior marginal spines; segment 5 narrowing distally; segment 6 somewhat longer, basally broadest. Brood plates of peraeopods 1 and 2 with 17–19 marginal setae, of gnathopod 2 with 4 apical setae; brood plate of peraeopod 3 with 2 minute hairs.

Pleosome side plate 3 with three groups of lateral plumose setae.

Pleopod rami (especially outer) basally broadest; inner ramus with 12 distinct segments, outer with 15.

Uropod 1: peduncle stout, longer than rami, upper margin distally spinose; outer ramus with two groups of posterior spines and terminal spine group; inner ramus much shorter (sometimes lacking) with posterior setae and terminal spines. Uropod 2: ramus slender, narrowly spatulate, setose, longer than weakly setose peduncle. Uropod 3: outer ramus 2-segmented, each distally with setae and spines; inner ramus shorter, with terminal spines and setae; peduncle very short. Telson short, subrectangular, entire, posterior margin with 3 spines on each side.

Male: Unknown.

REMARKS.—The inner ramus of uropod 1 was not present in two females of the Herring Brook material, a phenomenon that lessens the significance of the presence or absence of uropod rami as generic characters. The species is known only from short sandy estuaries of the western shore of Buzzards Bay, where it burrows often in company with *Haustorius canadensis* in sandy banks and bars, from low water to about midtide level.

Neohaustorius schmitzi, new species

FIGURES 1*i*, 2*d*, 4*j*, 18, 19

MATERIAL EXAMINED.—Morehead City, N.C., Shark Shoal, under algae ash on sandy beach, E. H. Schmitz, Sta. SSB–1, June 15, 1959: 1♀, holotype, 1♂, allotype (NMC 7026). Chatham, Mass., along sandy shore, 2–3 ft., Aug. 26, 1956, R. L. Wigley: 2♂♂, 2♀♀, 1 ov. (NMC 2027). Cape Cod region, Nobscusset Beach, open sand shore at low water, Sept. 9, 1963: 2 adult, 2 imm. (MBL, author collections).

DESCRIPTION.—Female, 4.2–5.3 mm. Head short and wide, rostrum broad acuminate, not exceeding anterolateral angles; inferior antennal sinus shallow. Eyes apparently lacking. Lateral lobes of peraeon long, widely separated, coxae shallow. Urosome lappet short. Antenna 1: peduncular segments sublinear, sparsely setose; flagellum 6-segmented, shorter than peduncle; calceoli elongate; accessory flagellar segments subequal. Antenna 2: posterior lobe of peduncular segment 4 narrow, not wider than segment proper, flagellum 4-segmented, 1 longer than 2 and 3 combined.

Upper lip rounded and minutely pilose apically. Lower lip: outer lobes thickly pilose; inner lobes very long and slender. Mandible: lacinia short, conical, 3 slender accessory blades; palp short, terminal segment longer and more slender than 2nd, 6 comb spines, about 10 slender terminal spines. Maxilla 1: inner plate narrow, with 7 bifurcate marginal setae; outer plate with 9 apical spine teeth; palp

with terminal group of nonplumose setae. Accessory lobe of coxopodite small, peripheral setae long. Maxilla 2: outer plate long and slender, lunate, double the inner plate, inner margin proximally with stout comb spines, distally with more than 20 plumose setae, outer margin finely ciliate. Maxilliped: inner plate short, truncate apex with 5 slender spines and one spine tooth on small prominence at inner angle; outer plate narrow, without marginal spine teeth; palp: inner margin of segment 2 slightly concave, terminal segment arcuate, tip not exceeding distal lobe of segment 2.

Gnathopod 1: coxal plate subrectangular, margin sparsely setose; segment 5 strong, posterior setae simple; segment 6 uniformly slender, slightly shorter than 5; dactyl short, nail a simple curved spine. Gnathopod 2: segment 2 straight; segment 5 narrow, lower margin proximally with a few slender setae, distally with about 10 short pectinate spines; segment 6 long and slender, upper margin convex, distally with slender pectinate spines; dactyl relatively large.

Peraeopod 1: coxal plate distally broadest, margins virtually bare; segment 2 strong, margins subparallel; segment 4 slightly expanded, margins sparsely plumose; segment 5 short and deep, spine circlet small, with about 8 spines; segment 6 pear shaped, with 9 spines. Peraeopod 2 slightly shorter, less powerful; coxal plate broadly expanded and produced posteriorly, margins nearly bare; segment 2 slender; segment 4 slightly expanded, upper margin nonplumose (?); posterior margins of segments 5 and 6 with 3 and 1 plumose setae respectively. Peraeopod 3: coxal plate large, deep, posterior margin nearly bare; segment 2 very broad, posterior margin weakly setose, anterior margin with a few plumose setae; segment 4 subtriangular, longer than broad; segment 5 narrow; segment 6 cylindrical, about equal to 5, facial spines short and heavy. Peraeopod 4: posterior coxal lobe shallow, margin nearly bare; segment 2 broader than long, posterior margin smoothly convex, nearly bare, segments 4 and 5 relatively narrow with 2–3 small clusters of stout facial spines; segment 6 short, cylindrical. Peraeopod 5 very nearly equal to 4; segment 2 very brood, strongly convex behind, nearly bare; segment 4: posterior to be subtriangular, segment 6 slender, longer than subrectangular 5. Coxal gills subcylindrical, longest on gnathopod 2, decreasing posteriorly; broad plates long and narrow on peraeopods 1 and 2 with about 20 marginal setae, short and narrow on gnathopod 2, vestigial on peraeopod 3.

Pleosome: side plate 3 small with 3 groups of lateral plumose setae. Pleopods strong, inner ramus 9–10 segmented, outer 12-segmented, inner marginal setae short. Uropod 1: peduncle short, stout, spinose above, single (outer) ramus heavy, with 3–4 groups of stout

posterior spines and longer apical spines. Uropod 2: ramus spatulate, slightly longer and more slender than nearly bare peduncle. Uropod 3: rami subequal, weakly setose apically, longer than peduncle. Telson very small, entire, with 2 short spines and a seta on each side of the slightly emarginate apex.

Male, 3.5 mm.: Somewhat smaller and more slender bodied than female. Antennae 1 with 1 elongate calceolus per flagellar segment. Gnathopods relatively shorter and stouter than in female.

REMARKS.—The animal occurs at low-water level of open sandy beaches from the southeast side of Cape Cod Bay and outer coast of the Cape, southwards to Georgia and northern Florida.

This remarkable species is named in honor of Dr. Eugene H. Schmitz, in whose littoral marine amphipod collections from the Beaufort region the species was first identified.

***Pseudohaustorius*, new genus**

Small to medium-sized haustoriids. Head very short and broad, lateral margins subparallel, rostrum and lateral head angles broad, inferior antennal sinus shallow. Lateral lobes of peraeon pronounced. Pleosome abruptly narrowing beyond peraeon 7; segment 2 broadest; posterior margin of segment 3 strongly reflexed below, side plate 3 with posterior spinous process. Urosome very short; urosome 1 very wide, overhung by pleosome, posteroventral lappet short; urosome 2 very short, dorsal margin nearly occluded by 1 and 3, nearly as broad as urosome 1.

Antenna 1: peduncular segments very short and broad, segment 2 heavily plumose anteriorly; accessory flagellum 2-segmented. Antenna 2: segment 4 deeply lobate behind; flagellar segment 1 elongate, plumose. Upper lip broad, apically subtruncate. Lower lip: inner lobe large, rounded. Mandibular incisor unicuspate, lacinia 1–2 cuspate, accessory blades few (3–4); palp stout, comb row long. Maxilla 1: inner plate small, marginal setae few, simple, accessory lobe vestigial or lacking. Maxilla 2: outer plate small, distal margin scantily plumose. Maxilliped short, inner plate small, palp very broad, terminal segment clavate.

Gnathopods slender, coxae broad. Gnathopod 1: dactyl with stout subterminal spine. Gnathopod 2: segment 5 with elongate pectinate spines below. Peraeopods 1 and 2 powerfully fossorial, posterior lobe of segment 5 large, spinose and setose. Coxal plates deep. Peraeopod 3: segments 4 and 5 extremely broad, short. Peraeopod 4: segment 5 articulated near anterior margin of segment 4; segment 6 spatulate. Peraeopod 5: coxal plate large, segment 5 with distinct posterior margin. Coxal gills smallest posteriorly. Brood plate on peraeopod 3 vestigial.

Pleopod outer ramus 15–20 segmented, slightly the longer. Uropods biramous. Uropod 1: rami stout, distally broadening, inner longest. Uropod 2 strong, richly setose, peduncle with stiff spine row. Terminal segment of outer ramus of uropod 3 short or lacking. Telson very broad, shallowly notched, entire, posterior marginal setae long and slender setose.

Type species.—*Pseudohaustorius caroliniensis*, new species.

Additional species.—*Pseudohaustorius americanus* (Pearse) 1908; *Pseudohaustorius borealis*, new species.

Remarks.—The present genus is similar to *Eohaustorius* Barnard 1957 in general aspect of the antennae, mouthparts, and peraeopods; however, the two genera differ significantly in the form of the maxilliped, lower lip, peraeopod 2, uropod 1, and telson. Similar functional demands may result in convergent evolution of certain appendages in widely separate phylogenetic lines.

***Pseudohaustorius caroliniensis*, new species**

Figures 30, 31

Material examined.—North Falmouth, Mass., intertidal, Aug. 17, 1951, M. Pettibone: 1 ♀, holotype, 1 ♀, paratype, ov. (USNM collections).

Description.—Female, 6.5–8.0 mm.: Head width more than twice the length, broadest posteriorly; rostrum short and broad, acute; antennal sinus shallow; eyes lacking.

Antenna 1: peduncular segment 3 slender, elongate, terminally bearing 5–6 segmented flagellum; accessory flagellum of two slender subequal segments, markedly subterminal. Antenna 3: peduncular segment 4 deeply expanded posteriorly and distally; segment 5 short, deep; flagellum of 8 unequal segments, subterminal segment longest, proximal segments plumose behind.

Upper lip minutely pilose at apex. Lower lip: inner lobes relatively narrow. Mandible: incisor conical, simple, left lacinia single, right unequally bifid, 3 accessory blades and one supramolar blade; palp with short terminal segment bearing 14 marginal comb spines and 13 slender apical pectinate spines. Maxilla 1: inner plate very small, with 2 marginal setae, outer plate with 11 small spine teeth; palp moderately strong, with marginal plumose setae; accessory baler lobe lacking. Maxilla 2: outer plate small, oblique, distal margin 4-plumose. Maxilliped: inner plate relatively broad and strong; outer plate with weakly toothed inner margin; palp segment 2 with short apical lobe; segment 3 broad clavate and strongly arched.

Gnathopod 1: coxal plate shallow, angle subacute, with 7 plumose setae; segment 5 slightly expanded; segment 6 elongate; dactyl

strong, with stout subterminal posterior spine. Gnathopod 2: coxal plate narrowing below, corner rounded; segment 5 elongate with numerous slender pectinate spines posterodistally; segment 6 short, slightly inflated, dactyl minute.

Peraeopod 1: coxal angle blunt; segment 2 not broadened; segment 4 expanding distally; segment 5: posterior lobe large, directed proximally, with circlet of 16 slender spines and 6 plumose setae; segment 6 with 10 spines and 5 plumose setae. Peraeopod 2: coxal plate narrow, moderately deep, angles subquadrate; segment 2 short, narrow; segment 4 short and very broad, especially distally; segment 5 short and deep, posterior lobe with circlet of 8 slender spines and 5 plumose setae; segment 6 with 7 spines and 5 plumes.

Peraeopod 3: posterior coxal lobe large, margin smooth; segment 2 shallow convex and slightly plumose behind. Segment 4 shallow, very broad, posterior margin truncate, with 2 spines; segment 5 shallower but very wide, facial spines in 3 rows; segment 6 short, linear, length less than width of segment 5, terminal spines long and slender. Peraeopod 4 coxal plate nearly as broad, posterior margin smooth; segment 2 relatively narrow, margin nearly straight, plumose; segment 4 expanding distally, facial spines in 3 vertical rows, 2–6 per cluster; segment 5 trapezoidal, distal margin sharply convex; segment 6 equal to width of 5, terminal spines slender, numerous. Peraeopod 5: posterior coxal lobe broad, very elongate, rounded behind; segment 2: posterior margin relatively small, lightly setose; segment 4 with short posterior lobe, truncate posterior margin with 1 spine group; segment 5 relatively long and narrow, posterior margin with one prominent spine group; segment 6 about equal in length, broad spatulate; marginal spines short and slender. Coxal gills saclike, slender, and shortest posteriorly. Brood plates slender, moderately long; those of gnathopod 2 and peraeopods 1 and 2 with 25–30 marginal setae; brood plate of peraeopod 3 a minute lobe with a few marginal hairs.

Pleosome side plate 3 deeply convex below, posterior spine fairly strong; 4 groups of facial plumose setae, 4–8 per cluster. Pleopods strong, peduncles very broad; inner rami with 12–13 segments, outer with 15 segments.

Uropod 1 small, peduncle slightly shorter than rami; inner ramus expanding distally, with 3 groups of marginal setae, 2–3 per group; outer ramus more slender and with marginal spines and setae. Uropod 2 relatively large, rami and peduncle, strong subequal, richly setose, some of which are plumose. Uropod 3 slightly shorter than uropod 2, rami subequal, terminal segment of outer ramus small and slender; ramal apices with spines and setae, some plumose. Telson short,

broad, shallowly V-cleft behind, lobes each with 12–13 stiff, slender posterior setae and 2 groups of lateral setae.

Remarks.—The present material was compared with the type male specimen of *Pseudohaustorius americanus* (Pearse), from Cameron, La. (USNM cat. 38340), portions of which are illustrated herewith (fig. 5c) and in Pearse (1908, p. 29). In the type of *P. americanus*, antenna 1 is damaged and the accessory flagellum appears to retain a minute basal fragment of a terminal segment, thus making the appendage 2-segmented. In maxilla 2, the distal margin of the outer plate is oblique. The terminal segment of the mandibular palp is short. In peraeopod 4, segment 4 is relatively short and broad, segment 5 longer than broad, segment 6 weakly spinose behind. In peraeopod 5, the coxal hindlobe is very large, the hindmargin of segment 2 irregularly convex, the hindlobe of segment 4 short, truncate, with 2 marginal spine groups, and the posterior border of segment 5 apparently long. Terminal spines of the rami of uropod 1 are short, pectinate. Outer ramus of uropod 3 1-segmented. Telson distinctly V-cleft apically.

P. caroliniensis is related closely to *P. americanus* (Pearse), particularly in the shape of peraeopod 5 and telson, but is distinct in possessing a small but definitive terminal segment on the outer ramus of uropod 2. Although recorded from New England by the present material, the species recently has been found in selected habitats of the estuaries of the Carolinas and Georgia. The specific name *caroliniensis* alludes to the principal zoogeographic affinities of the species.

The species is restricted ecologically to surf-protected muddy sand bottoms that are kept moist at low water by beach seeps or tidal runoff. When disturbed or trapped in the net, the animals appear very sluggish and crawl much more slowly than associated species of *Haustorius*, *Acanthohaustorius*, and *Parahaustorius*. Despite intensive search in 1963, the species was not rediscovered at the type locality.

***Pseudohaustorius borealis*, new species**

Figures 1*e*, 2*f*, 4*h*, 20, 21

Material examined.—*Albatross*-101, sta. 86, 41°14′, 67°28′, Smith grab, 24 fms., Aug. 24, 1957: 1♂, holotype, 1♀, allotypes (NMC 7064); same locality: 1♀, 1 imm., paratypes (NMC 7065).

Cape Cod region, off Pasque Island, Quick's Hole, coarse sand, grab at 45 ft., Sept. 18, 1963: 1 ♀, ov. (MBL, author collections). Off Cape Cod, 41°48′, 66°48′, April 10, 1953: 7 subadult; same locality, 41°24′, 66°44′, April 10, 1953: 1 ♀, 2 imm.; *Albatross*-69, coll. 1, 41°52′, 69°60′, Van Veen, Nov. 15, 1955: 5 adult; *Albatross*-101, sta. 68, 41°30′, 68°28′, Smith grab, Aug. 22, 1957: 7 imm.;

Albatross-101, sta. 85, 40°34′, 68°51′, Smith grab, Aug. 23, 1957: 1 frag., 1 imm.; *Delaware*, 59–9, sta. 24, 42°00′, 67°49′ Smith grab, Aug. 6, 1959: 2 imm. (USFW, R. L. Wigley collection). Sta. 186, 40°48′, 68°19′, Smith grab, 31 fms., Aug. 28, 1957: 1 imm. (NMC 7063).

Description.—Male, 6.5 mm. Head more than twice as wide as long, rostrum short, base broad, apex acute; eyes small, slitlike, just inside border of moderately deep antennal sinus; anterolateral angles of head acute.

Antenna 1 distinctly shorter than antenna 2; peduncular segment 1 very deep, lateral margin heavily plumose; segment 3 short; flagellum of 6 segments, segment 1 largest, calceoli not discernible in present material; subterminal accessory flagellum of 2 subequal segments. Antenna 2: peduncular segment 4 as deep as long, lobe extending distally, anterior margin with distal rows of short plumose setae; segment 5 short, broad, anterior setae short, fork tipped, flagellum of 5 segments, 1st much the largest, posterior margin plumose.

Upper lip broad, apex shallow convex, smooth. Lower lip: inner lobes very broad distally, nearly reaching border of broad outer lobes. Mandible incisor simple, conical, lacinia strong, acute, bicuspate on left side, single on right; 3–4 serrate accessory blades; molar process with filelike surface, 1 supramolar blade; palp short, strong, comb row of 10 short spines merging into apical cluster of 14 long, slender distally pectinate spines. Maxilla 1: inner plate very small, with 3 simple marginal setae; outer plate narrow, with 9 spine teeth; palp strongly arched, broadest in middle, outer margin with plumose setae; accessory lobe lacking (not observed in present material). Maxilla 2: outer plate slightly longer than inner, distal truncate margin with 3 plumose setae, inner margin with about 12 slender setae; inner lobe elliptical, facial row of setae straight. Maxilliped: apex of inner plate narrow, twin spines slender, subequal; outer plate margin smoothly convex, palp segment 2 very broad, apical process large, segment 3 short, strongly arched, broadest distally; setae long, simple.

Gnathopod 1: coxa shallow, posterior angle broadly rounding, with about 10 plumose setae; segment 2 somewhat arched, setose behind; segment 5 stout, heavily setose below; segment 6 slender, dactyl strong, with subapical ventral spine. Gnathopod 2: coxa lunate, posterior corner sharply rounded, heavily plumose; segment 2 sublinear, setose behind; segment 5 elongate, lower margin distally with clusters of slender pectinate spines; segment 6 slender subcylindrical, moderately arched, dactyl minute.

Peraeopod 1: posterior coxal angle acute, richly plumose; segment 2 very broad and strong, plumose distally behind; segment 4 convex margins plumose; segment 5: posterior lobe small, circlet of about 18 slender spines and 8 plumes; spatulate segment 6 with 11 spines and 9 plumose setae. Peraeopod 2: coxal plate very deep, with deep posterodistal margin deeply incised, posterior process acute; segment 2 stout, plumose behind; segment 4 short and powerful, convex margins plumose; segment 5 lobe short, circlet of about 10 slender spines and 9 setae, segment 6 with 11 spines and 8 setae.

Peraeopod 3: posterior coxal lobe expanded above and below, lower margin lightly setose; segment 3 orbicular, posterior margin strongly plumose; segment 4: proximal border of posterior lobe incised near base, 2 groups of spines on posterior margin; segment 5 nearly as broad as 4, 2 groups of long posterior spines; segment 6 longer than width of 5, marginal spines long. Peraeopod 4: coxa broad, slightly expanded above and below; segment 2 much broader than deep, posterior border plumose proximally; segment 4 much longer than wide, 3 rows of facial spines in fanwise clusters of 5–8 spines; segment 5 subquadrate, anterior margin convex, extending well forward of border of 4; segment 6 moderately long, subspatulate, 6 clusters of posterior and terminal spines. Peraeopod 5: coxa moderately deep, broadly acuminate and lightly setose behind; segment 2 very broad, smooth behind; segment 4: posterior lobe elongate, subacute, distal border very short, with 1 spine group; segment 5 slightly expanded, posterior border short, with 1 spine group; segment 6 slightly shorter, with 4–5 marginal spine groups and 3 small lateral clusters.

Pleosome side plate 3 deep, convex below, posterior tooth strong; 5–6 groups of lateral plumes setae, up to 10 per cluster. Pleopod peduncles very short and broad; outer ramus 18-segmented, slightly longer than 15-segmented inner ramus. Uropod 1: peduncle slender, weakly spinose; inner ramus with about 3 posterodistal clusters of setae, terminal spines slender; outer ramus slightly shorter, terminal circlet with slender spines and a long seta. Uropod 2: rami subequal, richly setose; stout peduncle with row of slender spines and distal cluster of plumose setae. Uropod 3 shorter than 2, rami broad, subequal, slightly longer than peduncle; terminal segment of outer ramus more than ½ the proximal segment; apex with spines and setae. Telson very broad, posterior margin almost straight, lobes each with 11 stiff slender setae; 2 lateral clusters of setae.

Female, 7.0 mm.: Externally similar to male. Brood plate on gnathopod 2 long and slender, somewhat broader on peraeopods 1 and 2, vestigial on peraeopod 3.

REMARKS.—The genus *Pseudohaustorius* is represented mainly along the coasts of the southeastern United States and the Gulf of Mexico (Bousfield, in prep.). *P. borealis* is probably the most northerly of the component species; hence, the specific name. It differs from *P. americanus* and *P. caroliniensis* mainly in the more elongate and spinose peraeopod 4, the smaller coxa of peraeopod 5, and the uncleft telson. It is also a deeper-water, more offshore species, not uncommon in the Georges Bank region to lat. 42°N.

Genus *Haustorius* Müller 1775

(emendation of Stebbing, 1906, Barnard, 1957)

Medium to large haustoriids. Head broadest medially, lateral margins strongly convex, rostrum strong, sharply acute, antennal sinus deep; body broad, strongly arched, lateral lobes of peraeon well developed; pleosome relatively short, abruptly narrowing beyond peraeon 7; hindmargin of segment 3 strongly decurved or reflexed; side plate (especially 3) margins rounded. Urosome markedly reduced, overhung by pleosome; urosome 1 short, posteroventral lappet well developed; urosome 2 very short.

Antenna 1: peduncular segment 2 margins thickly plumose; flagellum calceolate in both sexes, accessory flagellum 4-segmented. Antenna 2: peduncular segment 5 broad, not lobate behind; flagellum long, noncalceolate in male. Upper lip broad, apically pilose. Lower lip: inner lobes large, subtruncate distally. Mandibular incisor strong, few cuspate, lacina present on one side; accessory blades numerous (9–12); palp long, comb spines numerous. Maxilla: inner plate large, margin richly setose; palp slender; accessory baler lobe very large and long ciliate. Maxilla 2: outer plate extremely large, lunate, richly plumose; inner lobe long, narrow. Maxilliped plates narrow; palp with slender, sharply geniculate terminal segment.

Gnathopods slender, coxae semilunate. Gnathopod 1: dactyl simple, strong. Peraeopods 1 and 2 normally fossorial; posterior lobe of segment 5 in peraeopod 1 with median and marginal spines. Peraeopods 3–5, segments 4–5 broadly expanded. Peraeopods 4 and 5 not greatly longer than peraeopod 3. Peraeopod 4: segment 6 sublinear, not spatulate. Peraeopod 5: posterior border of segment 5 very short. Coxal gills slender, subequal. Brood plates slender, sparingly setose, vestigial on peraeopod 3.

Pleopods very strong, outer ramus 18–22-segmented, inner 15-segmented. Uropods biramous. Uropod 1: inner ramus not shorter than outer, with posterior spines and setae. Uropod 2: peduncle

long, rami short. Uropod 3: outer ramus with distinct terminal segment. Telson sharply incised, lobes apically spinose.

Type species.—*Haustorius arenarius* (Slabber) 1769.

Additional species.—*Haustorius canadensis* Bousfield 1962.

Haustorius canadensis Bousfield 1962

Figures 1*d*, 2*a*, 4*g*, 5*a*

Haustorius arenarius.—Paulmier, 1905, p. 157, fig. 25.

Material examined.—Saco, Maine, May 30, 1957, F. A. Chace, Jr.: 1 ♀, ov., 17 mm. (MCZ 8992). Brewster, Mass., along sandy shore, 2–4 ft., May 22, 1960, R. L. Wigley: 6 ♀♀, 1 ov., 6 ♂♂, 2 imm. (NMC 7077). Newburyport, Mass., May 26, 1943, C. E. Addy: 1 ♂ (USNM acc. 167331). Woods Hole region, Mass., Aug. 22, 1952 [no other data]: 2 ♂♂, 1 ♀ (USNM collections). Naushon, Mass., Tarpaulin Cove, July 21, 1893, W. P. Hay: 19 ♂♂, 13 ♀♀ (USNM 21827). Cape Cod, Mass., West Falmouth Marsh, 1–3 ft., Jan. 8, 1961, R. L. Wigley: 1 ♂ (NMC 7078). Falmouth, Mass., Sippewisset Marsh, 1–3 ft., Feb. 13, 1960, R. L. Wigley: 5 ♀♀, (br. II), 5 ♂♂, 2 juv. (NMC 7079). Newport, R.I., May 1893, S. D. Judd: 10 ♀♀, 7 ov., 19 ♂♂ (USNM acc. 34225); same locality, second lot: 9 ♂♂, 12 ♀♀. Sagaponack Lake, 3 miles south of Bridgehampton, N.Y., Aug. 18, 1938, H. K. Townes: 4 ♂♂, to 17 mm (USNM acc. 149428). Arundel-on-the-Bay, Md., W. P. Hay: 115 specimens (USNM acc. 22157).

Cape Cod region, Mass.: Little Sippewisset Marsh, sand banks near mouth of estuary, low water to midwater, Sept. 8, 1963: 4 ♀♀, 2 ♂♂, 3 imm.; Great Sippewisset Marsh, sand bars above mouth, midwater level, Sept. 8, 1963: 1 imm.; Nobscussett Beach, sand flats at breakwater, midwater level, Sept. 9, 1963: 1 imm. (MBL, author collections). Northern New England, 1963: 431 specimens obtained at 8 stations, mostly from inter-tidal sandbanks at the mouths of small estuaries, from East Sandwich, Mass., north to Biddeford Pool (Casco Bay), Maine, including Plum Island, Mass., Seabrook Beach, N.H., Cape Neddick Beach, Ogunquit, Pine Pt., Maine (NMC, author collections).

Remarks.—Material from New England, particularly from Connecticut and Long Island region, reaches a larger size (to 18 mm.) and has a more pronounced rostrum (fig. 1*d*) than specimens from the Gulf of St. Lawrence. The smaller, short rostrate type occurs throughout the Cape Cod region and northward. The large animals (17–18 mm.) are probably adults that have survived into the second year of reproduction.

The material of Paulmier (1905) now can be referred with certainty to this species. The known range is from the Gulf of St. Lawrence to Chesapeake Bay. A similar but long rostrate form occurs from North Carolina southwards (Bousfield, in prep.). The species is confined to the intertidal and wave zone sandbars and banks, especially at the mouths of estuaries. The animal burrows in the sand to a depth of 4 inches or more when the tide is out.

Acanthohaustorius, new genus

Small to medium large, generally similar to *Haustorius* (sensu stricto). Head broadest medially, margins convex, rostrum broadly acute. Peraeon lateral lobes prominent. Pleon narrowing abruptly behind peraeon, side plates acuminate, 3rd produced posteriorly into stout spinous process. Urosome somewhat reduced, longer than pleon 3, which overhangs it more or less. Urosome 1 stout, postero-ventral lappet short. Urosome 2 as long as urosome 3, but narrower than uropod 1.

Antenna 1: flagellum usually calceolate, accessory flagellum 2-segmented. Antennae 2: peduncular segment 4 deeply lobate, segment 5 broad, setose; flagellum: basal segment largest. Upper lip broad rectangular, apex smooth. Lower lip: inner lobes broad; outer lobes: inner margin subtruncate. Mandibular incisor mono- or bicuspate, lacinia simple on right side only, accessory plates fairly numerous (5–13). Maxilla 1: inner plate setae distally plumose; accessory baler plate moderately large. Maxilla 2: outer plate broad, not elongate, apex blunt, inner margin plumose distally; inner plate narrow. Maxilliped: plates broad; palp segment 3 stout, geniculate.

Gnathopod 1: segment 5 usually stout. Gnathopod 2: segment 6 slender. Peraeopods 1 and 2 not exceptionally powerful, posterior lobes of segment 5 short, coxa of peraeopod 2 very broad. Peraeopods 3–5: segments 4–5 moderately expanded. Peraeopods 4 and 5 not excessively lengthened, peraeopod 3 more than ⅔ peraeopod 5. Coxal gills smallest posteriorly. Brood plates rather large, broad, margins richly setose, very small on peraeopod 3. Pleopods strong, outer ramus 13–20-segmented, inner 10–15-segmented. Uropod 1: peduncle stout, inner ramus shorter, spinose and setose behind. Uropod 2 strong, rami and peduncle subequal. Uropod 3: terminal segment of outer ramus long. Telson broad, sharply and deeply notched.

Type species.—*Acanthohaustorius millsi*, new species.

Additional species.—*Acanthohaustorius intermedius*, new species; *A. spinosus* (Bousfield) 1962; *A. shoemakeri*, new species.

Acanthohaustorius millsi, new species

FIGURES 1*b*, 3*f*, 4*b*, 22, 23

MATERIAL EXAMINED.—Woods Hole, Mass., Stony Beach, sand, subtidal, June 29, 1961, E. L. Mills: 1 ♀, ov., holotype (NMCM 7050); same locality: 5 ♀♀, paratypes (NMC 7051). Cape Cod, Mass., near Nobska Point, sandy beach below low water, Aug. 16, 1959, E. L. Mills: 125 specimens, including ♂♂ and ♀♀ ov. (NMC 7052). Woods Hole, Mass., east end of Nobska Beach, fine sand at low water, Aug. 26, 1961, E. L. Mills: 64 specimens including ♂♂, ♀♀, ov., 1 imm. (NMC 7053); east side Nobska Point, fine sand, low water, July 28, 1962, E. L. Mills: about 200 specimens (NMC 7054). Cape Cod, Mass., Marshfield, coarse sand, low water, Aug. 20, 1961, D. Frankenberg: 4 ♀♀, 3 ov., 2 ♂♂, 9 imm. (NMC 7055); Nobska Beach, sand at low water, May 12, 1962, E. L. Mills, E. L. Bousfield: 10 ♀♀, 8 ov., 9 ♂♂, 2 imm. (NMC 7056); Barnstable Harbor, sandy channel opposite town wharf, low water, May 13, 1962, E. L. Bousfield, E. L. Mills, E. Deichmann: 12 ♀♀, 9 ov., 12 ♂♂, 6 imm. (NMC 7057). Falmouth, Mass., Sippewisset Marsh, sand, 1–3 ft., Feb. 13, 1960, R. L. Wigley: 11 ♀♀ (br. II), 1 ♂ (NMC 7058). Brewster, Mass., sand, 2–4 ft., May 22, 1960, R. L. Wigley, 1 imm. (NMC 7059). *Albatross*-101, sta. 86, 41°14′, 67°28′, Smith grab, 24 fms., Aug. 24, 1957: 1 imm. (NMC 7060). *Albatross*-101, sta. 89, 41°29′, 67°28′, Smith grab, 27 fms., Aug. 24, 1957: 4 ♂♂ (NMC 7061). *Albatross*-101, sta. 186, 40°48′, 68°19′, Smith grab, 31 fms., Aug. 28, 1957: 4 ♂♂, 1 ♀ (br. II) (NMC 7062). Isles of Shoals, N.H., N.W. 146, D2, July 19, 1937: 1 imm. (USNM 668/541).

Cape Cod region, Cedar Island (Nonamesset Island), Nobska Beach, Megansett breakwater, Little Sippewisset Beach, Nobscusset Beach, Wild Harbor, Herring Brook, Narragansett Beach, mouth of Pattaquamsett Inlet, sandy bottoms, low water, September 1963: 1000+ specimens (MBL, author collections). Chatham, Mass., Feb. 22, 1960: 19 adults; Old Silver Beach, Jan. 31, 1930: 47 subadults; same locality, Feb. 13, 1960: 2 ♀♀, 9 imm. Woods Hole, Ram Island, July 16, 1955: 2 adults; Vineyard Sound, L. Tashmoo, Nov. 13, 1962: 3 adults; same locality, Middle Ground, from *Blueback* 62–1, April 5, 1912: 15 adults; *Albatross*-69, coll. 1, 41°52′, 69°60′, Van Veen, Nov. 15, 1955: 7 adults; *Albatross*-101, sta. 68, 41°06′, 68°00′, Smith grab, Aug. 24, 1957: 1 adult.

Northern New England, 1963: about 1150 specimens obtained at 16 localities, from East Sandwich and the Cape Cod Canal north to Casco Bay and Pemaquid Beach, Maine, including Rockport and Plum Island, Mass., Cape Neddick Beach, and Ogunquit, Maine (NMC, author collections).

Description.—Female, 5.5–8.0 mm. Head width about twice the length, lateral margins evenly convex, rostrum stout, blunt conical, eyes very small, weakly pigmented, just inside margin of antennal sinus.

Antenna 1: peduncular segment 1 very deep, with numerous plumose setae; segment 2 anterior margin with numerous long distally plumose setae; segment 3 short, linear; flagellum 6-segmented, calceolate, elongate; accessory flagellum of 2 long subequal segments. Antenna 2: peduncular segment 4 very deeply lobed behind, margin richly plumose, face with 2 rows of plumose bladelike setae; segment 5 short and broad; flagellum 7-segmented, lst longest, proximal 4 segments with posterior plumose setae.

Upper lip broad, apex almost bare. Lower lip: inner lobes broadening distally, apices subtruncate, pilose. Mandible: incisor bifid; lacinia short, slender; accessory blades 7, molar process large, 2 supramolar blades; palp segment 2 broadest proximally, 3rd uniformly slender, 18 spines in comb row, 12–13 slender apical spines. Maxilla 1: inner plate small with 10 setae; outer plate with 12 slender spine teeth; palp short, with simple marginal and terminal setae; accessory lobe moderately developed. Maxilla 2: outer plate very broad, outer margin short pilose, inner margin proximally with 14 slender pectinate spines and distally with about 20 plumose setae; inner lobe narrow, facial row strong, sinuous. Maxilliped: outer plate much broader than inner, palp rather slender, segment 2 produced distally almost to long transverse margin of geniculate segment 3; terminal setae very long, many bifid at tip or minutely pectinate.

Gnathopod 1: coxal angle acute, with about 8 long plumose setae; segment 2: posterior margin simply setose; segment 5 very strong and inflated, lower margin richly setose; segment 6 slender, convex anterior margin with several clusters of long club-tipped setae; dactyl short, simple. Gnathopod 2: coxal angle acute, rounded, with about 12 plumose setae; segment 2 slender, gently sinuous; segment 5 slightly inflated, lower margin distally with about 4 clusters of pectinate spines; segment 6 slender, gently arched, a few anterior setae plumose.

Peraeopod 1: coxal plate semilunate, posterior angle very acute, posterior margin with more than 12 plumose setae; segment 2 linear; segment 4: subparallel margins with several long plumose setae; segments 5 and 6 with about 10 slender marginal spines and 4 plumose setae. Peraeopod 2: coxal plate broad and deep, posterior sinus shallow; segment 2 short, linear; segment 4: distally expanding margins with several plumose setae; segments 5 and 6 with 9–10 slender spines and 4–5 plumose setae. Peraeopod 3: posterior coxal lobe the larger, margin distally setose; segment 2: smoothly convex

posterior margin with proximal setae; segment 4 broader than deep, one group of posterior spines and 4–6 groups of facial spines; segment 5 much broader than long, posterior lobe produced distally, 3 rows of facial spines; segment 6 linear, with 5 groups of anterior spines and a few long terminal spines. Peraeopod 4: coxal plate shallow; segment 2 not broader than deep; segment 4 with about 5 posterior marginal spines and 3 rows of short facial spines; segment 5 quadrate, posterior margin nearly straight; segment 6 short and linear with 3 posterior spine groups and longer terminal spines. Peraeopod 5: coxal plate with subacute posterior lobe; segment 2 orbicular, posterior margin virtually bare; segment 4 short, posterior lobe considerably produced, posterior margin short, with 2 spines; segment 5 longer than 6, distally broadest, with virtually no posterior margin, facial groups of setae only; segment 6 basally broad, marginal spines rather long. Brood plates broad, long, those of peraeopods 1 and 2 with 30–50 marginal setae, that of gnathopod 2 smaller; plate of peraeopod 3 a small lobe with 6–7 marginal hairs. Coxal gills elongate anteriorly.

Pleosome side plate 3 produced posteriorly into a long stout spur or spine; about 6 clusters of lateral plumose setae. Side plates 1 and 2 posteriorly acuminate. Pleopods with rather slender rami; inner 12-segmented, outer 17-segmented.

Uropod 1: peduncle slender, longer than rami, posterior margin with a few slender spines; 3 short inter-ramal spines; rami slender, spinose above, terminal spines long; inner ramus with 4 long, singly inserted, marginal setae and terminal spine cluster. Uropod 2: rami and peduncle subequal, densely setose. Uropod 3: outer ramus slightly longer than inner, 2 segments subequal, distally with numerous long simple setae; peduncle slender. Telson broad, cleft nearly to base, lobes strongly arched medially, margin with slender spines.

Male, 4.5–7.0 mm.: Very similar to female, slightly smaller. Antenna 2 noncalceolate. Slender penes arise ventrally on peraeon 7 near base of coxae, and are directed medially.

Remarks.—This is one of the most common species of semiprotected sand beaches in the Cape Cod region. Like *Protohaustorius deichmannae*, it is common northward to Casco Bay, Maine, but is not known from Canada. The species probably extends much further southward than the present New England records indicate. It occurs from the lower intertidal zone to depths of 27 fathoms and in salinities from estuarine to fully marine. The species is named in honor of Dr. Eric L. Mills, who collected the material from which this and other new haustoriid species initially were recognized.

***Acanthohaustorius intermedius*, new species**

FIGURES 1*c*, 3*e*, 4*a*, 24, 25

MATERIAL EXAMINED.—Barnstable Harbor, Mass., Beach Point, coarse sand, low water, 12°C., May 19, 1962, E. L. Mills: 1 ♀, holotype, 1 ♂, allotype (NMC 7046); same locality: 6 ♀♀ (5 ov.), 3 ♂♂, paratypes (NMC 7047). *Albatross*-101, cruise 70, coll. 5, 40°51′, 68°20′, Digby bag, 25 fms., Dec. 7, 1955: 1 ♂ (NMC 7048). *Albatross*-101, sta. 86, 41°14′, 67°28′, Smith grab, 24 fms., Aug. 24, 1957: 2 ♀♀, 3 imm. (NMC 7049). U.S. Fish Comm. *Fish Hawk* sta. 1802, 1874: 10 adult specimens. Cape Cod Bay, Nobscussett Beach, open sand near breakwater, low-water level, Sept. 9, 1963: 5 adult, 45 imm. (MBL, author collections). *Albatross*-101, sta. 63, 41°26′, 68°19′, Smith grab, Aug. 24, 1947: 2 ♀♀, ov.; *Albatross*-101, sta. 70, 40°57′, 67°52′, Smith grab, Aug. 24, 1957: 2 adults; Vineyard Sound, Middle Ground, from *Blueback*, April 5, 1962: 12 adults (USFW, R. L. Wigley collection).

DESCRIPTION.—Female, 4.5 mm. Head wider than long, outer margins smoothly convex, rostrum broad and blunt, antennal sinus moderately deep. Eyes apparently lacking. Body strongly arched. Pleosome segments very broad; margin of pleon 3 produced mid-dorsally as a large blunt-conical posterior process.

Antenna 1: peduncular segment 1 very short, deep, segment 2 subequal in length; flagellum of 5 slender segments, accessory flagellum equally 2-segmented. Antenna 3 peduncular segment 4 with short posterior lobe; segment 5 tumid; flagellum 5-segmented, 2nd segment smallest. Upper lip: apex smooth. Lower lip: inner lobes very broad apically. Mandibular incisor simple, incisor unicuspate, 5 accessory blades; palp slender, comb row of 9 short spines, apex with 9 slender spines. Maxilla 1: inner plate small, with 7 marginal setae; palp short, sparingly setose; accessory baler lobe shallow. Maxilla 2: outer plate expanded, length about 1½ times the inner plate, apex blunt, inner margin distally with about 12 plumose setae. Maxilliped: inner plate short, broad; outer plate convex laterally; palp short and broad, terminal segment stout, distal margin short.

Gnathopod 1: coxa rounded below, with 3 posterior plumose setae; segment 2 linear; segment 5 moderately expanded, ventral setae cleft tipped; segment 6 much shorter. Gnathopod 2: coxa with 7 posterior setae; segment 2 very slender; segment 5 longer than linear segment 6, with 3 groups of ventrodistal comb spines.

Peraeopod 1: coxal plate semilunate, posterior margin with 8 plumose setae; segment 4 not expanded, weakly plumose; segment 5 shallow, posterior lobe with 10 circlet spines and 1 plumose seta; segment 6 small, with 8 marginal spines. Peraeopod 2: coxal margin strongly convex below, segment 4 little expanded, margins plumose;

segment 5 very short, lobe circlet with 5 spines and 5 plumose setae; segment 6 slender, with 8 spines and 3 setae.

Peraeopod 3 relatively large, length more than ⅔ peraeopod 4. Coxal plate deeply lobate, hindmargin weakly setose; hindmargin of segment 2 nearly straight, proximally setose; segment 4 about as wide as long, outer face with 6–7 clusters of spines; segment 5 much narrower, 3–4 spine clusters; segment 6 short and stout, terminal spines long. Peraeopod 4: coxal plate small, posterior margin oblique, setose below; segment 2 relatively narrow, setose proximally; segment 4 triangular, posterodistal margin with 3–4 long spines; segment 5 subquadrate, distal margin straight, perpendicular to long axis, anterior marginal spines long; segment 6 short, linear, 3 posterior spine clusters. Peraeopod 5: coxa shallow, subtruncate behind; segment 2 large, orbicular, posterior margin bare, anterior margin distally with long bladelike setae; segment 4: posterior lobe short, acute, hindmargin very short, 1 spine group; segment 5 triangular, posterior margin distinct, 1 spine group, anterior marginal spines elongate, cleft tipped; segment 6 short, cylindrical, terminal spines long. Posterior coxal gills short, saclike. Brood plates on peraeopods 1 and 2 narrow, about 20 marginal setae, short and slender with 8 apical setae on gnathopod 2, a small plate with 2 apical hairs on peraeopod 3.

Pleon side plate 3 with short, weak, posterior spinous process. Pleopod rami short, broad, outer 13-segmented, inner 9–10 segmented. Uropod 1: peduncle long, evenly spinose posteriorly; 3 moderately strong inter-ramal spines; inner ramus much shorter than outer, hindmargin with 3 singly inserted setae; outer ramus with terminal cluster of long spines. Uropod 2: rami and peduncle subequal, some setae plumose. Uropod 3: rami subequal, segments of outer ramus subequal. Telson broad, narrowly cleft almost to base, lobes apically with a few slender setae.

Male, 3.5 mm.: similar but smaller than female; calceoli on first 4 flageller segments of antenna 1 elongate, each about equal to 2 flagellar segments.

Remarks.—Several features of this species (e.g., relatively small outer plate of maxilla 2, short terminal segment of maxilliped, weakly expanded peraeopods, short spinous process of pleon 3, and short inner ramus of uropod 1) are intermediate between the condition in primitive haustoriids (e.g., *Protohaustorius*) and the condition in highly specialized members of the genus *Haustorius;* hence, the specific name *intermedius*.

The species is known only from the Cape Cod region and occurs sparingly from the shoreline (in Cape Cod Bay) to more than 20 fathoms (on Georges Bank).

Acanthohaustorius spinosus (Bousfield) 1962

FIGURES 1*a*, 3*d*, 4*c*, 26, 27

MATERIAL EXAMINED.—Gulf of Maine, *Delaware* dredge haul no. 5, sta. 100, 42°41′, 66°28′, 80 fms., Aug. 8, 1959: 1 ♀ (br. II), (NMC 7044). Scotian Shelf, 100 miles off Halifax, *A. T. Cameron* sta. 64, 43°32′, 63°01′, dredge haul, 100 fms., May 8, 1961, S. W. Gorham: 11 ♀♀, 6 ov., 10 ♂♂, 5 imm. (NMC 7045).

Vineyard Sound, Mass., Quick's Hole, SE entrance, sand, 45 ft. grab. Sept. 18, 1963: 14 adult, 6 imm. (MBL, author collections). No. 540, 67°27′, 41°02′, June 17, 1953: 1 ♂, (USFW, R. L. Wigley collections).

REMARKS.—Author's figures (1962b) are reproduced here (with slight alterations) for comparative purposes and generic diagnosis. The present material contains males of 6–8 mm. in size. These are similar to the females in external appearance. Antennae 1 and 2 apparently lack calceoli in either sex. This species shows features that are akin to the genus *Parahaustorius*, namely, the strongly spinose peduncle of uropod 1, the shortened urosome segment 2, the relatively small peraeopod 3, and the posteriorly broadening head. The subspatulate form of segment 6 of peraeopod 4, and the broadly subtruncate telson, apically long setose, are typical of the genus *Pseudohaustorius*. Until further material can be studied, it seems advisable to define the genus *Acanthohaustorius* sufficiently broadly to include *A. spinosus*. This species has a remarkable bathymetrical range, from the lower intertidal of sandy beaches in the Bay of Fundy to depths of 100 fathoms on the Scotian Shelf. The present records extend its geographical range southward to Georges Bank and the south side of the Cape Cod peninsula.

Acanthohaustorius shoemakeri, new species

FIGURES 28, 29

MATERIAL EXAMINED.—Marthas Vineyard, Mass., off Gay Head, *Fish Hawk* sta. 1126–28, 9–14 fms., Aug. 28, 1882: 1 ♀, holotype, 1 ♀, ov., paratype (USNM 33727).

DESCRIPTION.—Female, 6.0–6.5 mm. Head shape similar to that of *A. intermedius;* eyes not observed in present material.

Antenna 1: peduncular segment 2 slender, nearly equal to segment 1; flagellum 9–10-segmented; accessory flagellum of 2 slender subequal segments, subterminally attached to peduncle 3. Antenna 2: peduncular segment 4 moderately deep, smoothly convex and richly plumose behind; flagellum 7-segmented, 1st longest, plumose posterodistally.

Upper lip smooth. Lower lip: inner lobes short, broad; outer lobes smoothly rounding, inner margin with about 7 well-spaced bristles. Mandible: incisor and lacinia short, unicuspate; 8 accessory blades and 1 supramolar blade; palp segments 2 and 3 slender, subequal; comb row of 20 short spines; 13 slender terminal spines. Maxilla 1: inner plate with 12 dendritic marginal setae; outer plate with 11 spine teeth; palp short, setae simple; accessory baler lobe moderately strong. Maxilla 2 longer than broad, inner margin with 18 proximal spines and 20 distal plumose setae; inner lobe long and narrow. Maxilliped inner plate with 12 marginal bristles; outer plate broad, with strong inner marginal spine teeth; palp slender; segment 2: apical lobe with straight outer margin, inner margin with minutely pectinate, curve-tipped setae.

Gnathopod 1: coxal angle broadly rounded, plumose; segment 2 slender; segment 4 powerful, posterior marginal setae clavate; dactyl with simple terminal nail. Gnathopod 2: coxal angle broad, plumose; segment 2 very slender, sinuous; segment 4 slightly expanded, with 4 groups of posterodistal pectinate spines; segment 6 very slender, chela relatively large.

Peraeopod 1: coxal plate deep, semilunate; segment 4 distally expanding, margins distally plumose; segment 5 long, with 14 marginal spines and 2 plumose setae; segment 6 with 10 spines and 3 plumose setae. Peraeopod 2: coxal plate broad, posterior marginal sinus moderately deep; segment 2 linear; segment 4 short, expanded, margins plumose; segment 5 small, with 6 marginal spines and 4 plumose setae; segment 6 with 10 spines and 3 plumose setae.

Peraeopod 3: posterior coxal lobe slightly the larger, weakly setose behind; segment 4 slightly broader than deep, with 5 groups of facial spines; segment 5 narrower, with 1 group of posterior spines, segment 6 stout, terminal spines not exceptionally long. Peraeopod 4: segment 2 nearly smooth behind; segment 4 short with 2 rows of facial spines, posterior margin concave proximally, convex distally, and armed with about 5 strong spines; segment 5 quadrate, distal margin perpendicular to axis, anterior marginal spines long; segment 6 linear with 4–5 posterior spine groups. Peraeopod 5: coxal plate deep, posterior lobe short, acute; segment 2 orbicular; segment 4: posterior lobe moderately produced, tapering to short posterior margin bearing 3–4 slender spines among plumose seatae; segment 5 with few facial setae, anterior marginal spines long, cleft tipped; segment 6: marginal spines long.

Brood plates of peraeopods 1 and 2 long and broad, with 35–40 marginal setae; that of gnathopod 2 much shorter, with 12 distal setae; that of peraeopod 3 forming a slender lobe with 4–5 posterodistal setae. Anterior coxal gills slender, elongate.

Pleosome side plate 3 with strong posterior spine and 6 facial clusters of plumose setae, 5–10 per cluster; side plates 1 and 2 acuminate behind, lower margin of side plate 1 strongly incised. Pleopods: rami with 13–16 distinct segments; peduncles each with 2 coupling spines.

Uropod 1: peduncle stout, posterior margin lined with strong spines, largest distally; outer ramus strong, nearly equal in length to peduncle, margins distally spinose; apical spines long; inner ramus weak, tapering distally, with a few weak posterior spines and slender setae. Uropod 2 large, rami and peduncle subequal, densely setose. Uropod 3: rami long and slender, outer ramus with subequal segments each longer than peduncle. Telson very broad, shallow, and deeply cleft; lobes rounded behind, margins with numerous slender stiff setae.

Remarks.—This species is generally similar to *A. millsi* but more closely resembles *A. intermedius* in shape of head, peraeopod 5, and uropod 1. The limited material at hand suggests it is a deeper water offshore species of sandy mud bottoms. The species is named in recognition of the significant contributions to the systematics of North American haustoriid amphipods made by the late Mr. C. R. Shoemaker and for his preliminary unpublished diagnoses of several of the species described in this paper.

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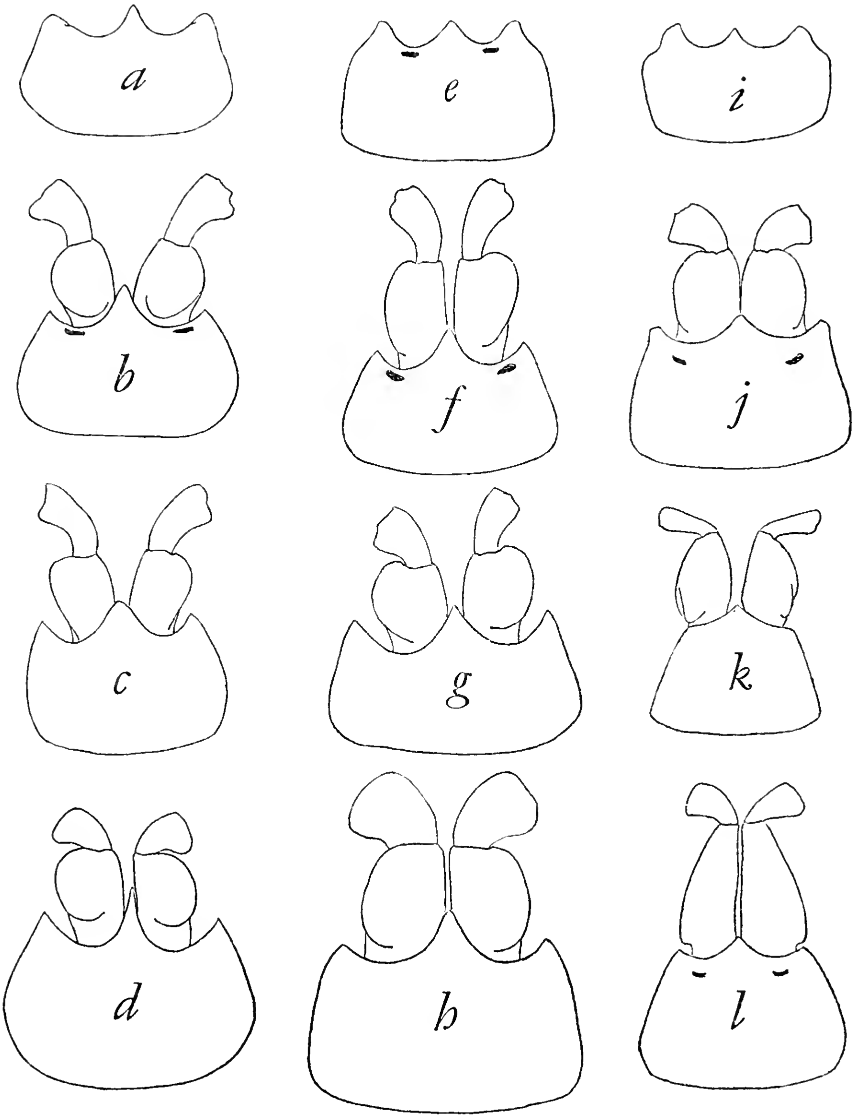

FIGURE 1.—Head and antennal peduncular segments, dorsal aspect: *a*, *Acanthohaustorius spinosus* (Bousfield) 1962, ♀, 12.5 mm., Sandy Cove, N.B.; *b*, *A. millsi*, new species, ♀, 8.0 mm., Nobska Beach, Mass.; *c*, *A. intermedius*, new species, ♀, 4.5 mm., Barnstable Harbor, Mass.; *d*, *Haustorius canadensis* Bousfield 1962, ♀, 11.3 mm., Newport, R.I.; *e*, *Pseudohaustorius borealis*, new species, ♂, 6.5 mm., off Cape Cod, *Albatross*-101, sta. 86; *f*, *Parahaustorius longimerus*, new species, ♀, 10 mm., Barnstable Harbor, Mass.; *g*, *P. attenuatus*, new species, ♀, 14 mm., off Block Island, N.Y.; *h*, *P. holmesi*, new species, ♀, 10 mm., Vineyard Sound, Mass.; *i*, *Neohaustorius schmitzi*, new species, ♀, 4.5 mm., Morehead City, N.C.; *j*, *N. biarticulatus*, new species, ♀, 5.0 mm., Nobska Beach, Mass.; *k*, *Protohaustorius deichmannae*, new species, ♀, 6.0 mm., Barnstable Harbor, Mass.; *l*, *P. wigleyi*, new species, ♀, 7.5 mm., off Cape Cod, *Albatross*-101, sta. 89.

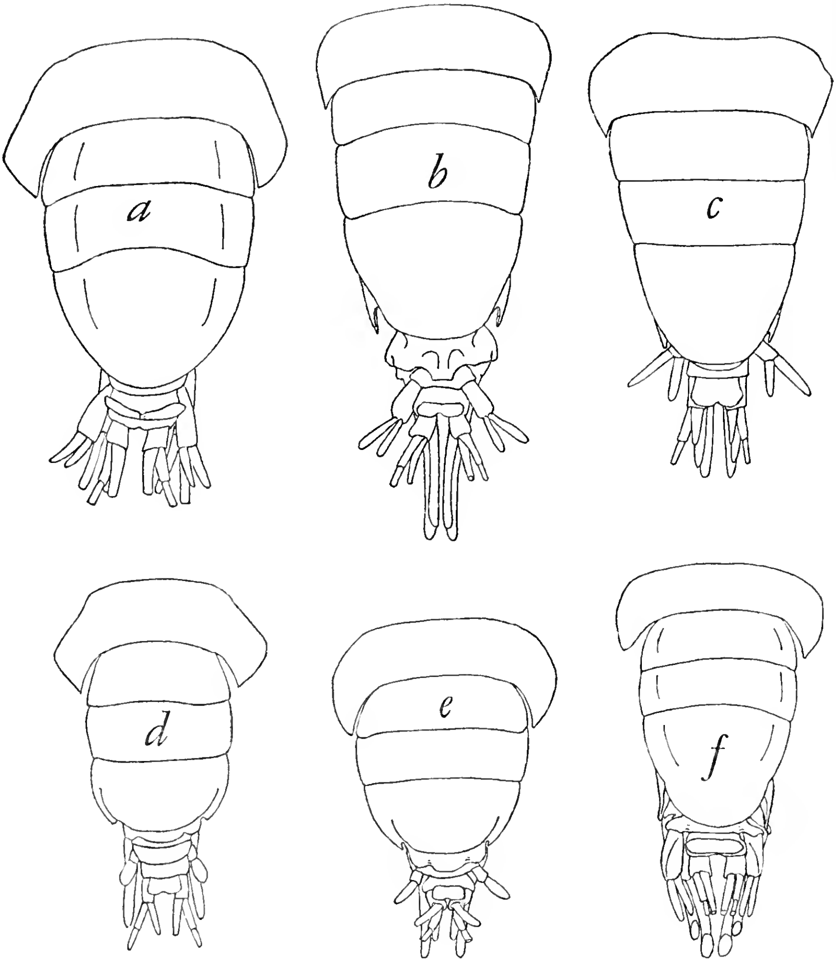

FIGURE 2.—Abdomen and peraeon 7, dorsal aspect: *a*, *Haustorius canadensis* Bousfield 1962; *b*, *Protohaustorius wigleyi*, new species; *c*, *P. deichmannae*, new species; *d*, *Neohaustorius schmitzi*, new species; *e*, *N. biarticulatus*, new species; *f*, *Pseudohaustorius borealis*, new species.

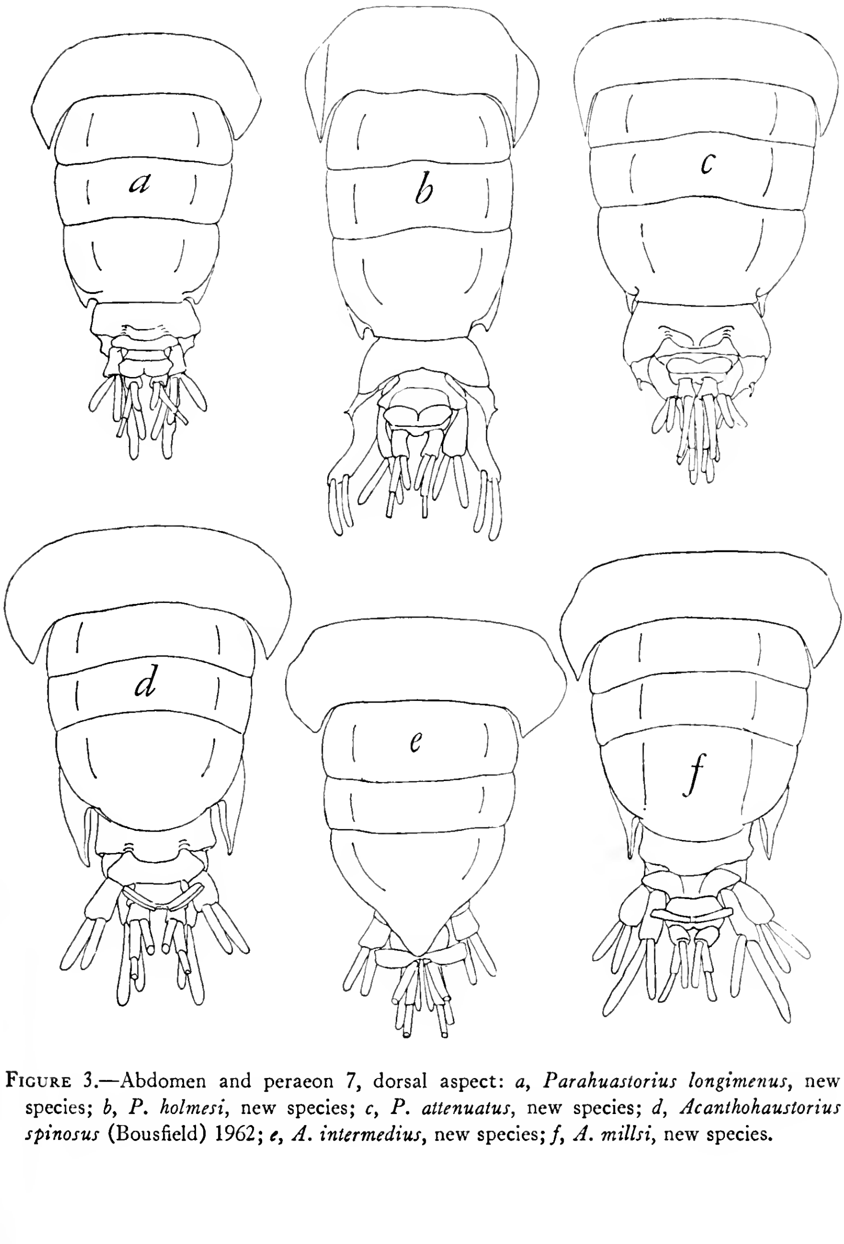

FIGURE 3.—Abdomen and peraeon 7, dorsal aspect: *a, Parahuastorius longimenus*, new species; *b, P. holmesi*, new species; *c, P. attenuatus*, new species; *d, Acanthohaustorius spinosus* (Bousfield) 1962; *e, A. intermedius*, new species; *f, A. millsi*, new species.

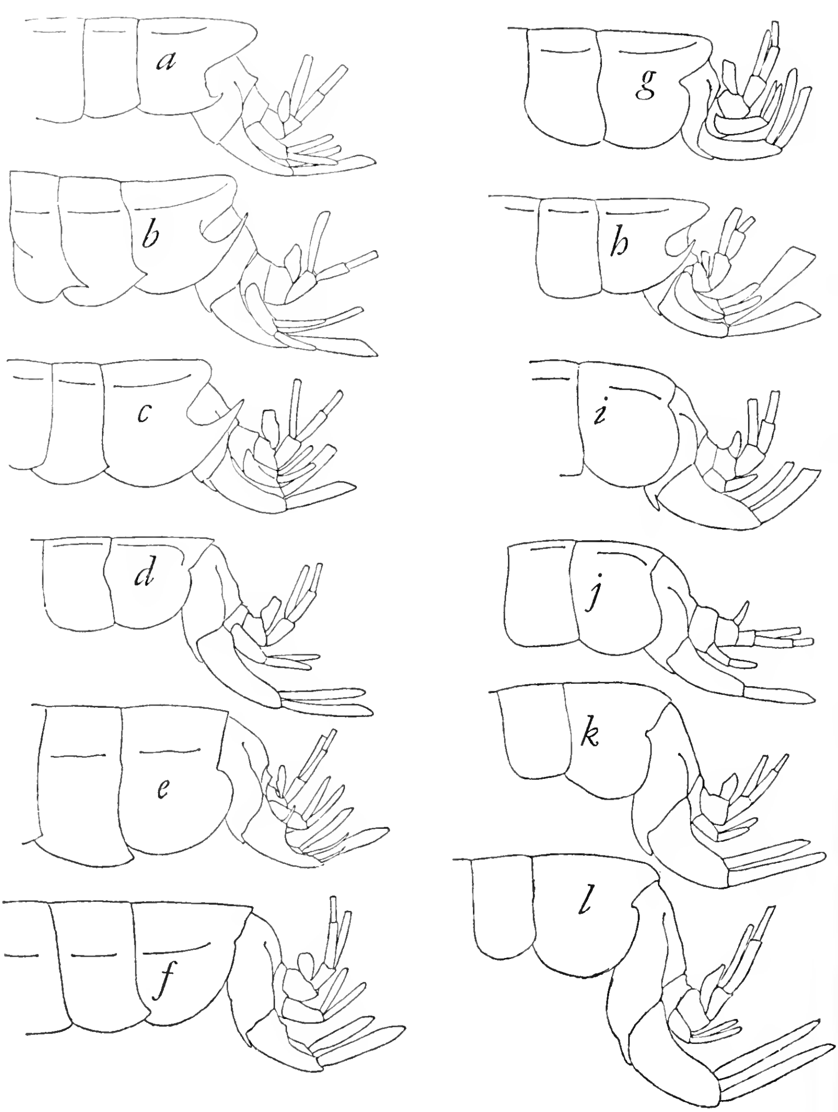

FIGURE 4.—Abdomen, lateral aspect: *a*, *Acanthohaustorius intermedius*, new species; *b*, *A. millsi*, new species; *c*, *A. spinosus* (Bousfield) 1962; *d*, *Parahaustorius longimerus*, new species; *e*, *P. attenuatus*, new species; *f*, *P. holmesi*, new species; *g*, *Haustorius canadensis* Bousfield 1962; *h*, *Pseudohaustorius borealis*, new species; *i*, *Neohaustorius biarticulatus*, new species; *j*, *N. schmitzi*, new species; *k*, *Protohaustorius deichmannae*, new species; *l*, *P. wigleyi*, new species.

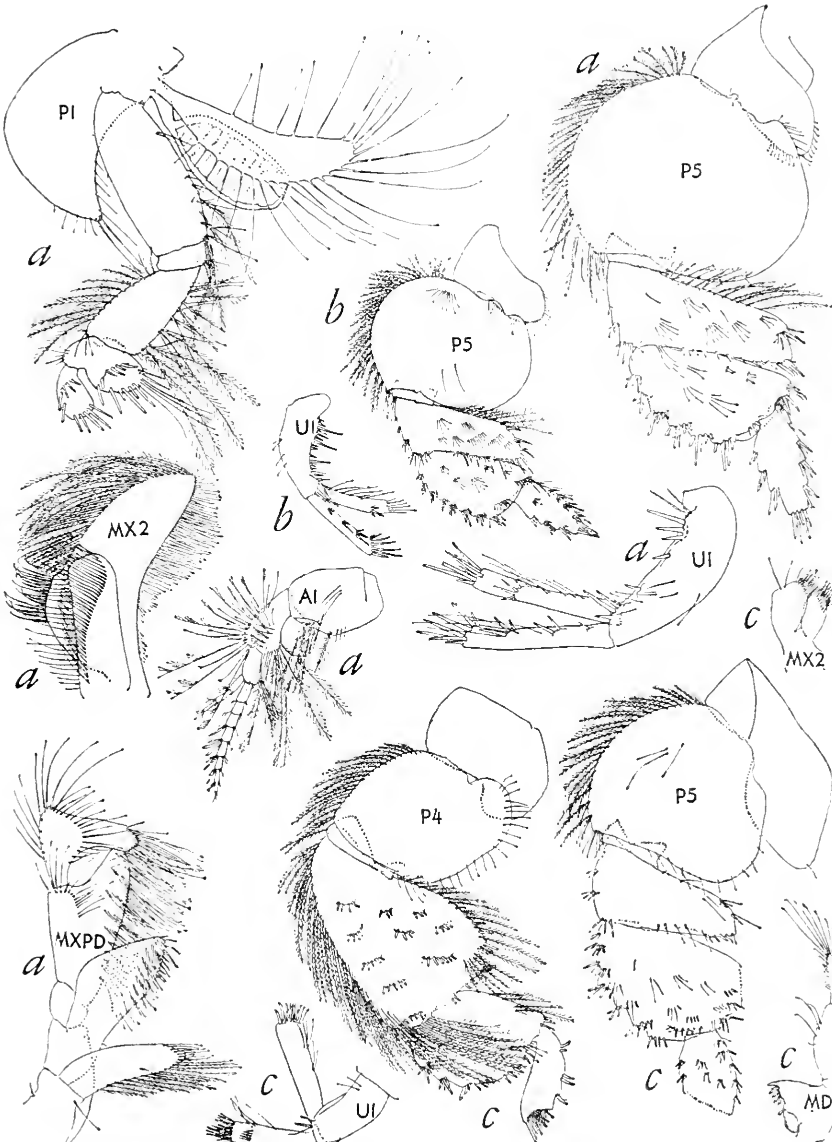

FIGURE 5.—Body appendages: *a*, *Haustorius canadensis* Bousfield 1962, Keppoch Beach, P.E.I.; *b*, *H. arenarius* (Slabber) 1769, Lokken, Denmark; *c*, *Pseudohaustorius americanus* (Pearse) 1908, Baton Rouge, La.

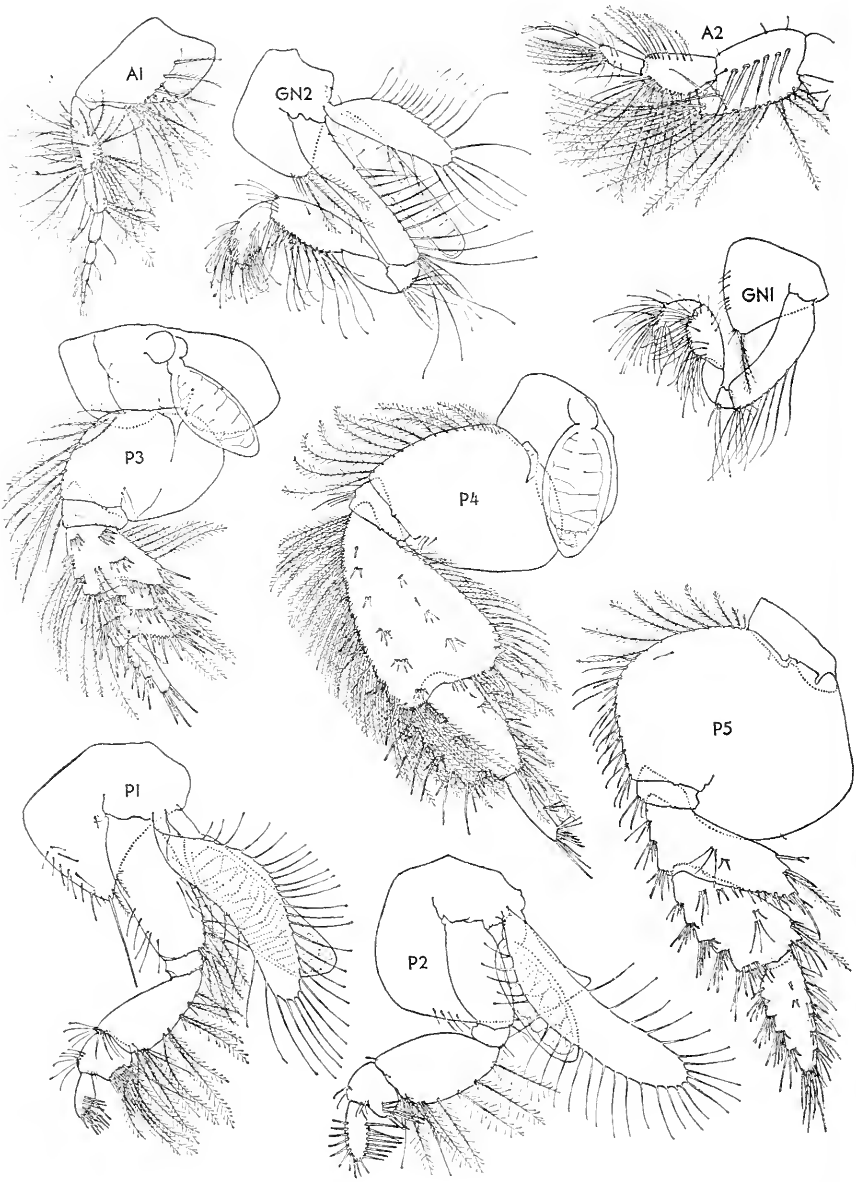

FIGURE 6.—*Protohaustorius deichmannae*, new species, ♀, 6.0 mm., holotype, Barnstable Harbor, Mass.

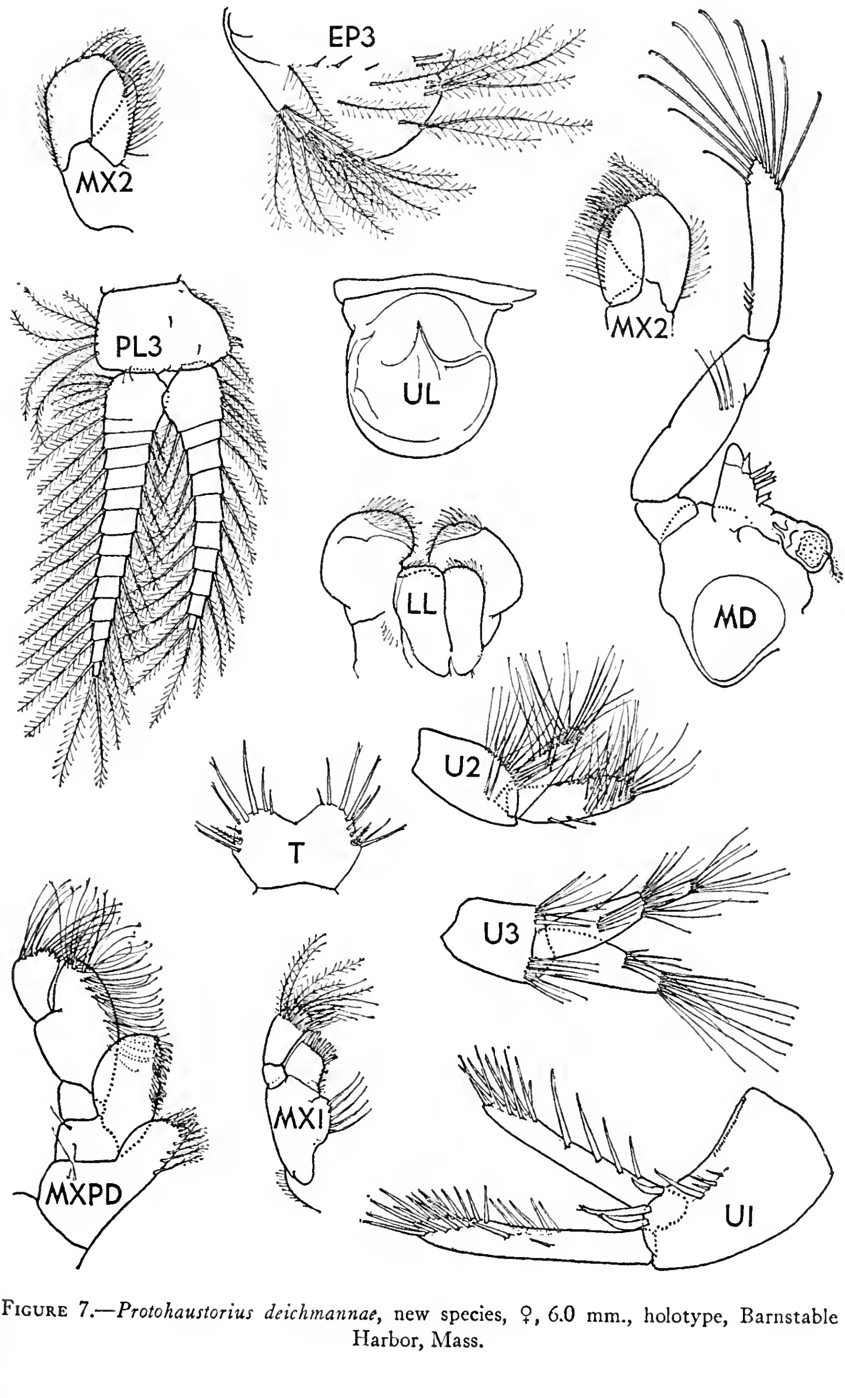

FIGURE 7.—*Protohaustorius deichmannae*, new species, ♀, 6.0 mm., holotype, Barnstable Harbor, Mass.

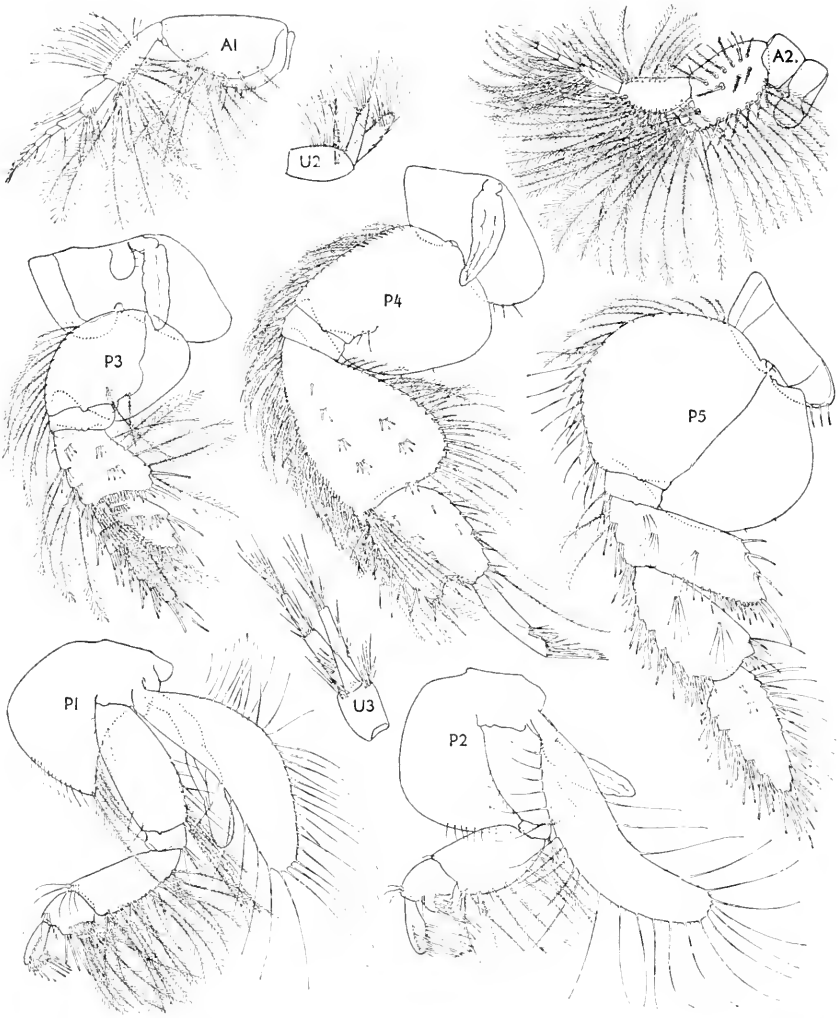

FIGURE 8.—*Protohaustorius wigleyi*, new species, ♀, 5.5 mm., holotype, off Cape Cod, Mass., *Albatross*-101, sta. 89.

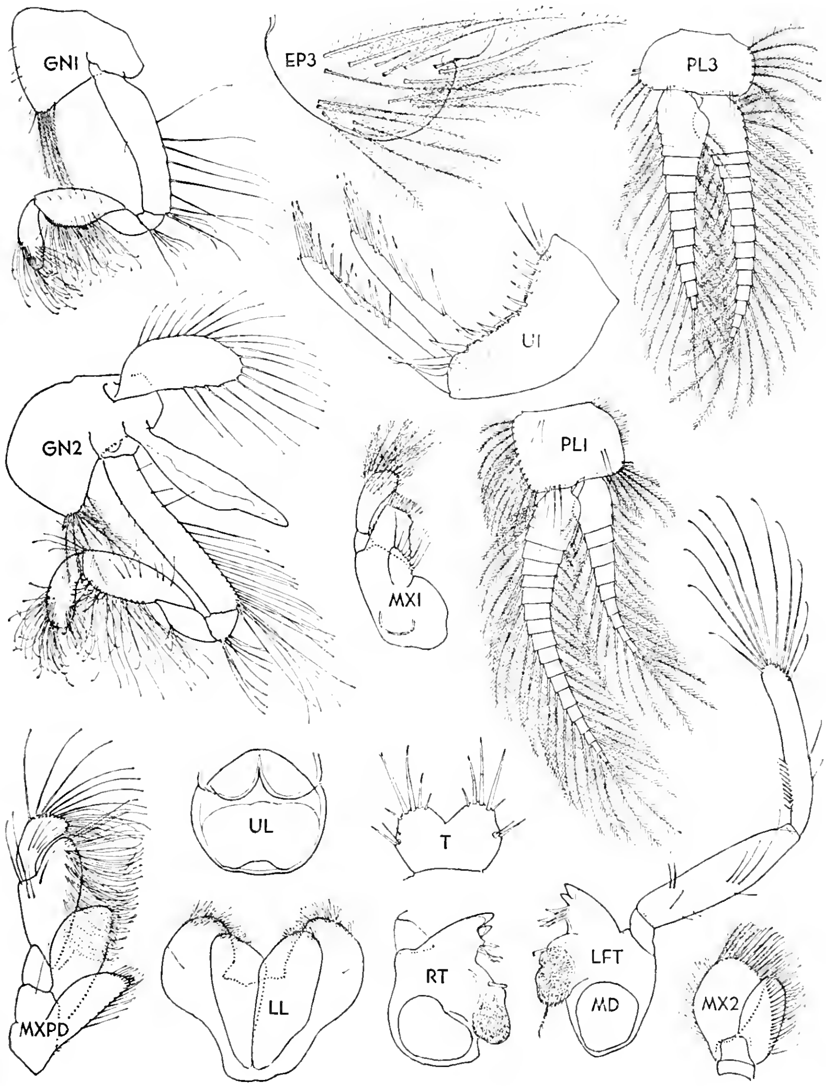

FIGURE 9.—*Protohaustorius wigleyi*, new species, ♀, 5.5 mm., holotype, off Cape Cod, Mass., *Albatross*-101, sta. 89.

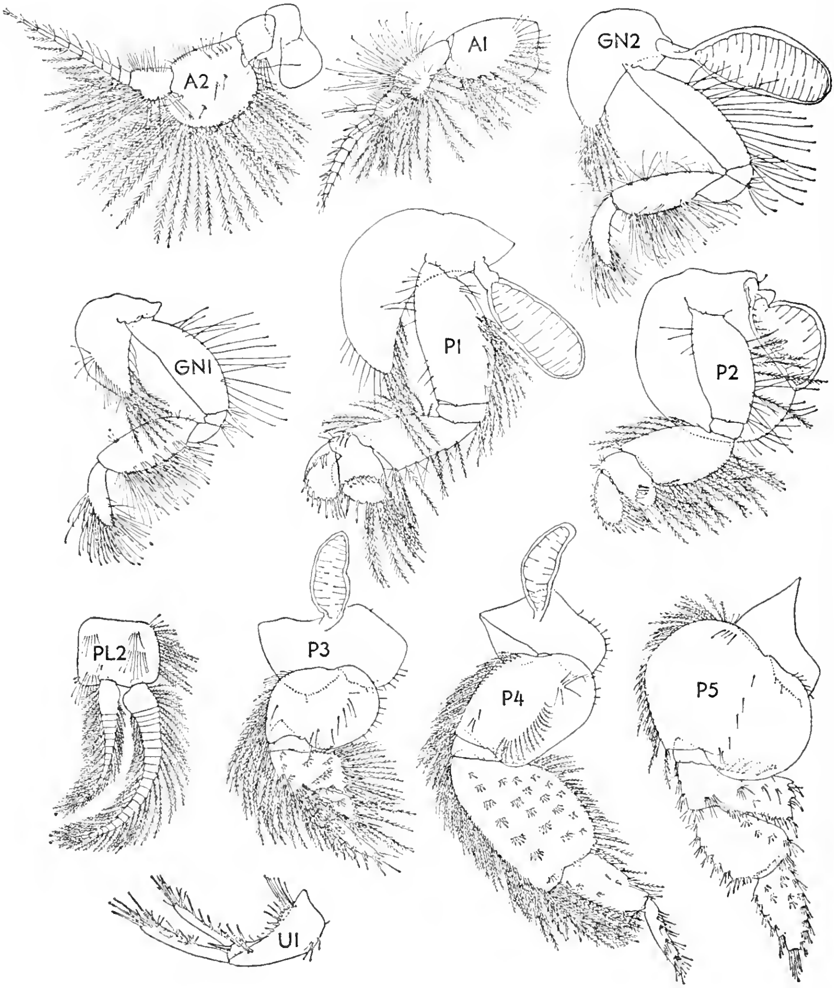

FIGURE 10.—*Parahaustorius longimerus*, new species, ♂, 9.5 mm., holotype, Barnstable Harbor, Mass.

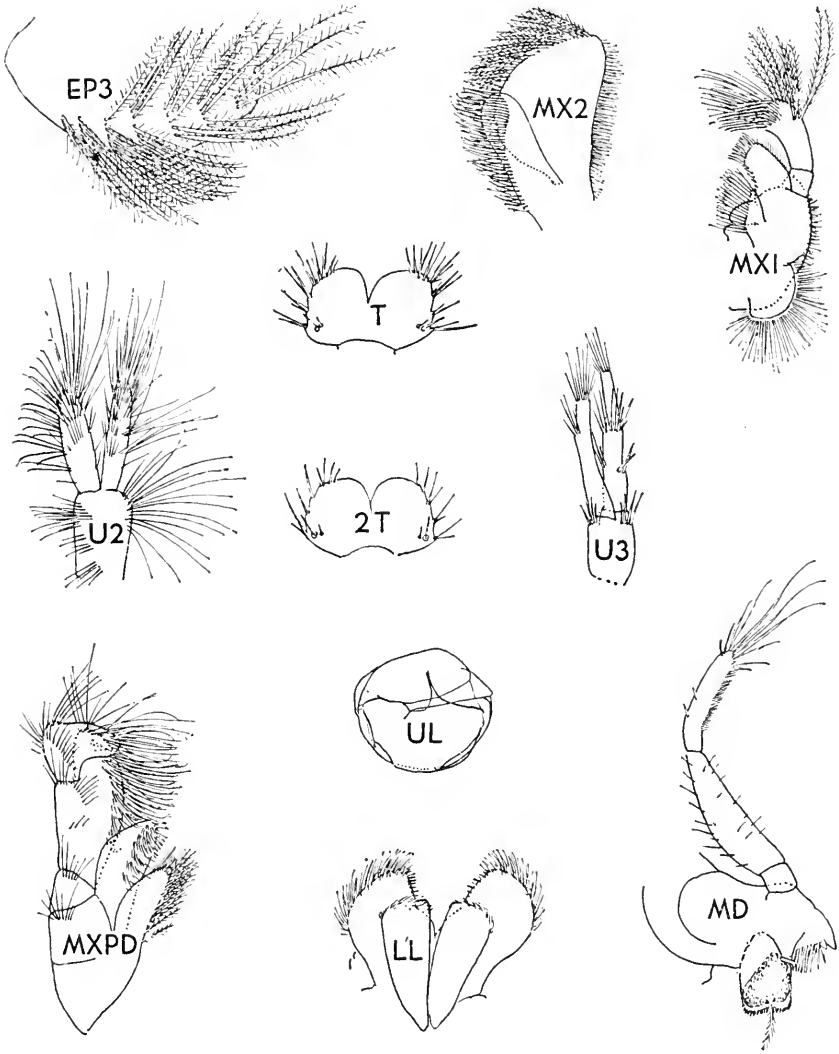

FIGURE 11.—*Parahaustorius longimerus,* new species, ♂, 9.5 mm., holotype, Barnstable Harbor, Mass.

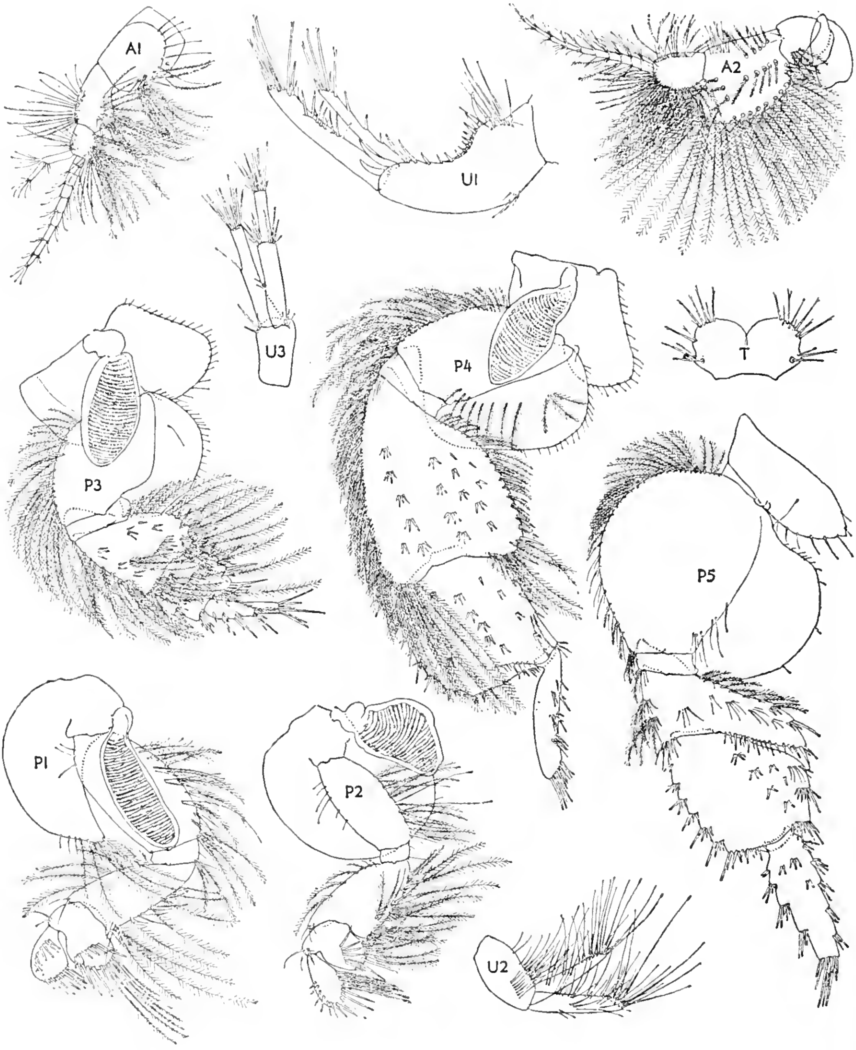

Figure 12.—*Parahaustorius holmesi*, new species, ♂, 10 mm., holotype, off New England Creek, N.J.

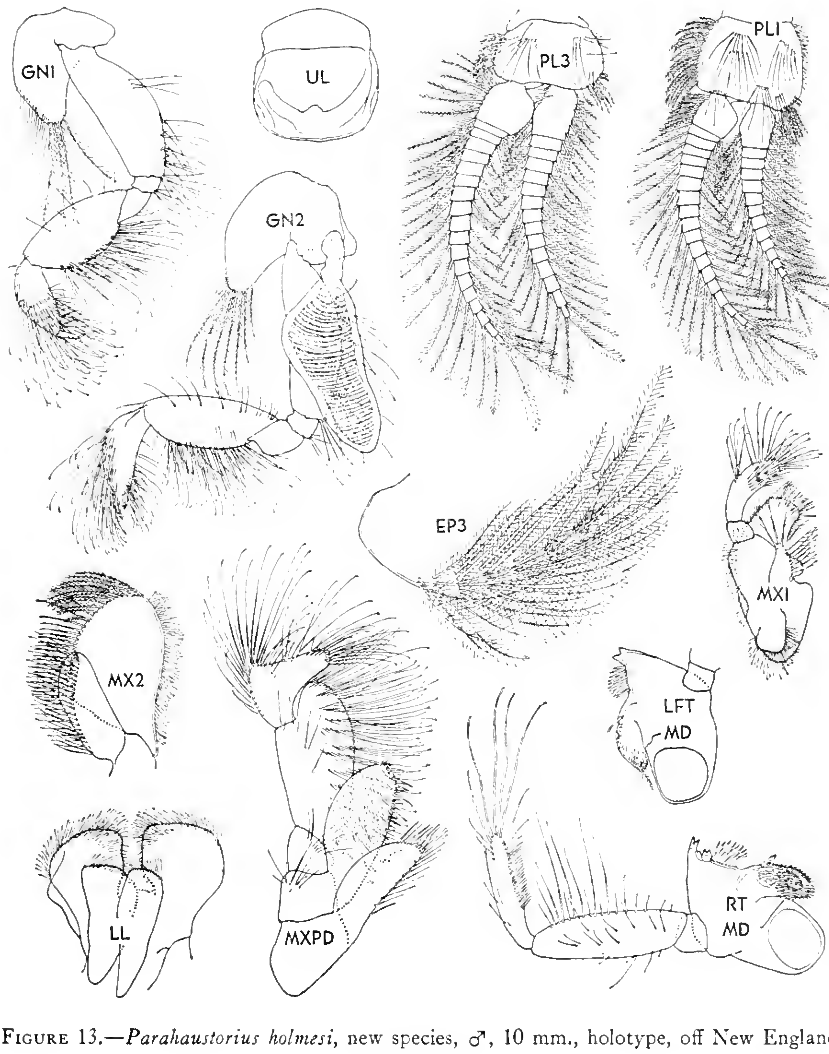

FIGURE 13.—*Parahaustorius holmesi*, new species, ♂, 10 mm., holotype, off New England Creek, N.J.

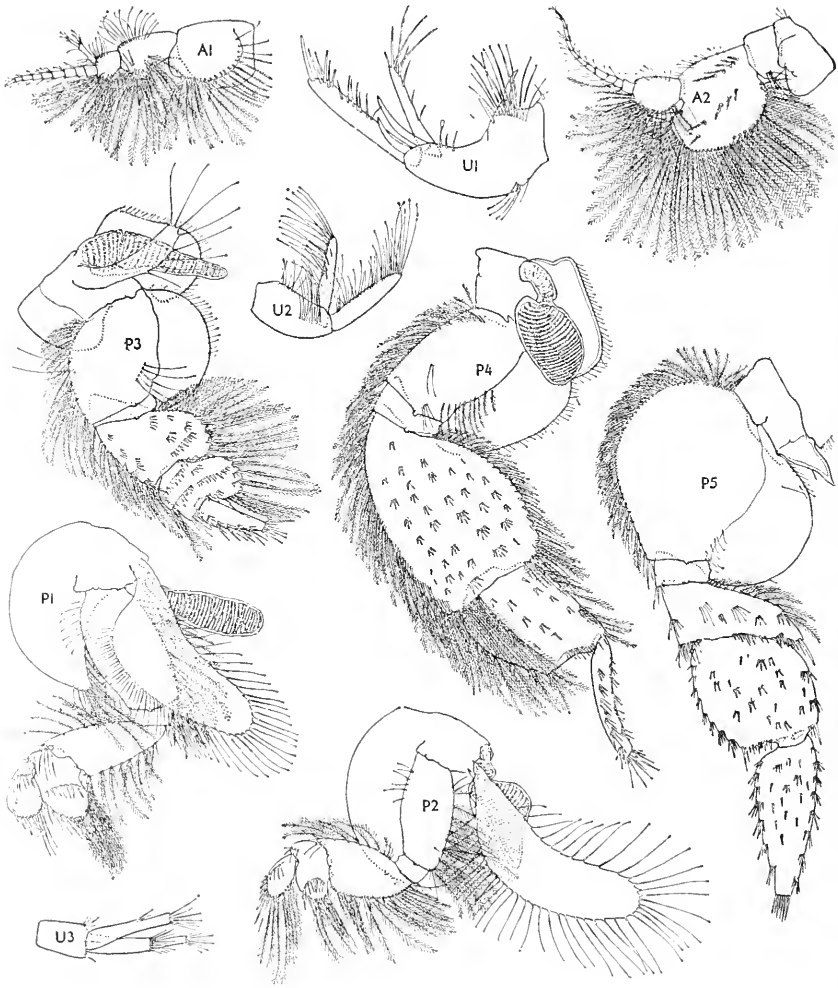

FIGURE 14.—*Parahaustorius attenuatus*, new species, ♂, 12.5 mm., holotype, sta, 156 New Jersey.

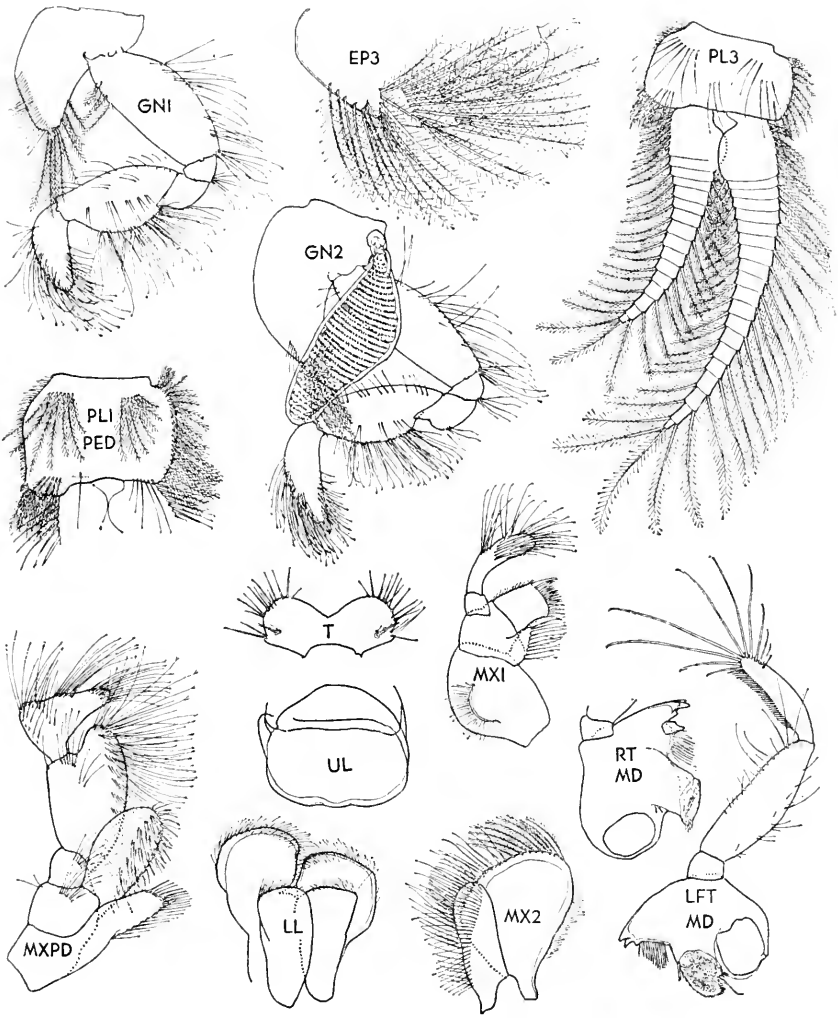

FIGURE 15.—*Parahaustorius attenuatus*, new species, ♂, 12.5 mm., holotype, sta. 156, New Jersey.

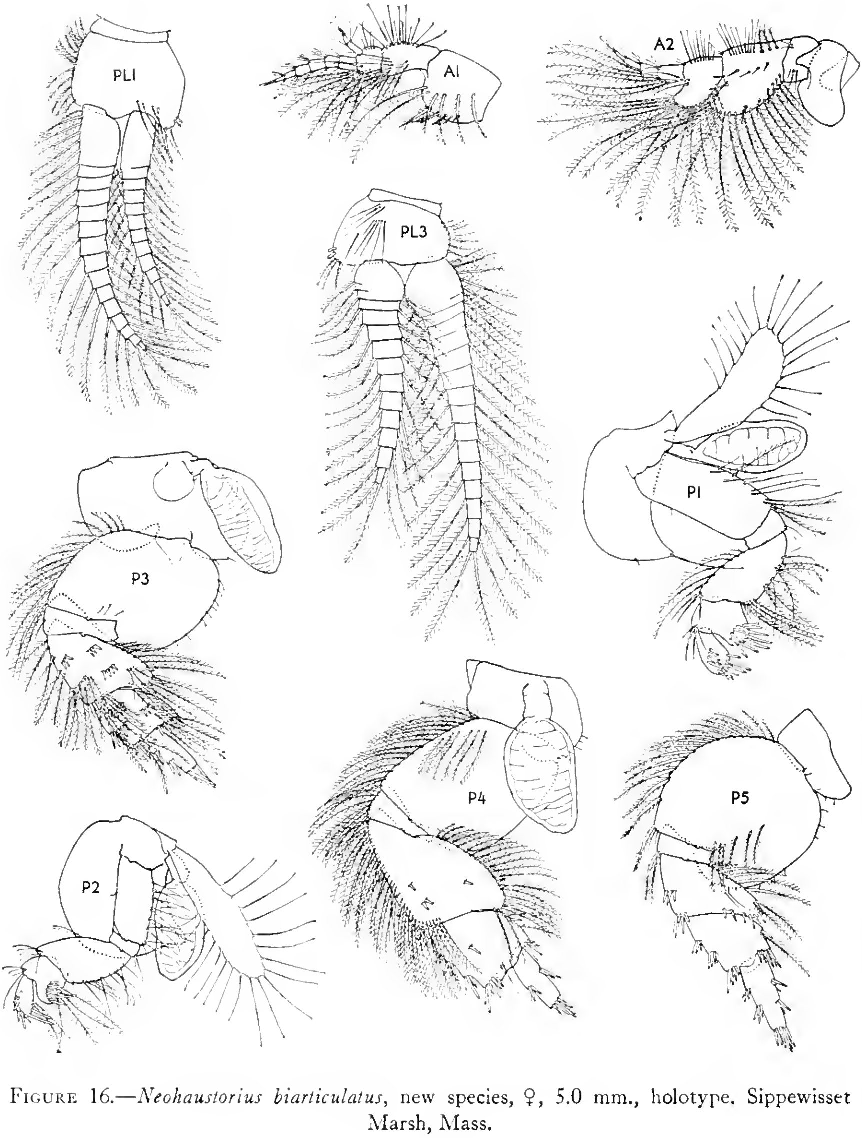

FIGURE 16.—*Neohaustorius biarticulatus*, new species, ♀, 5.0 mm., holotype. Sippewisset Marsh, Mass.

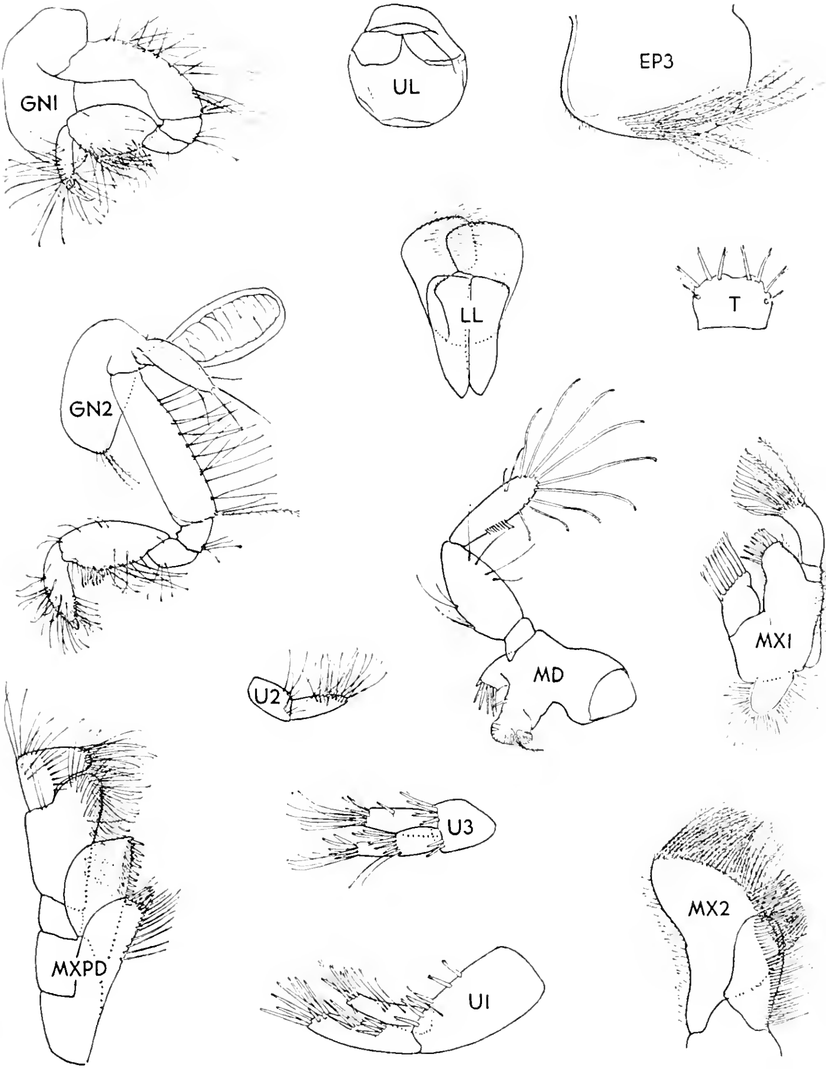

FIGURE 17.—*Neohaustorius biarticulatus*, new species, ♀, 5.0 mm., holotype, Sippewisset Marsh, Mass.

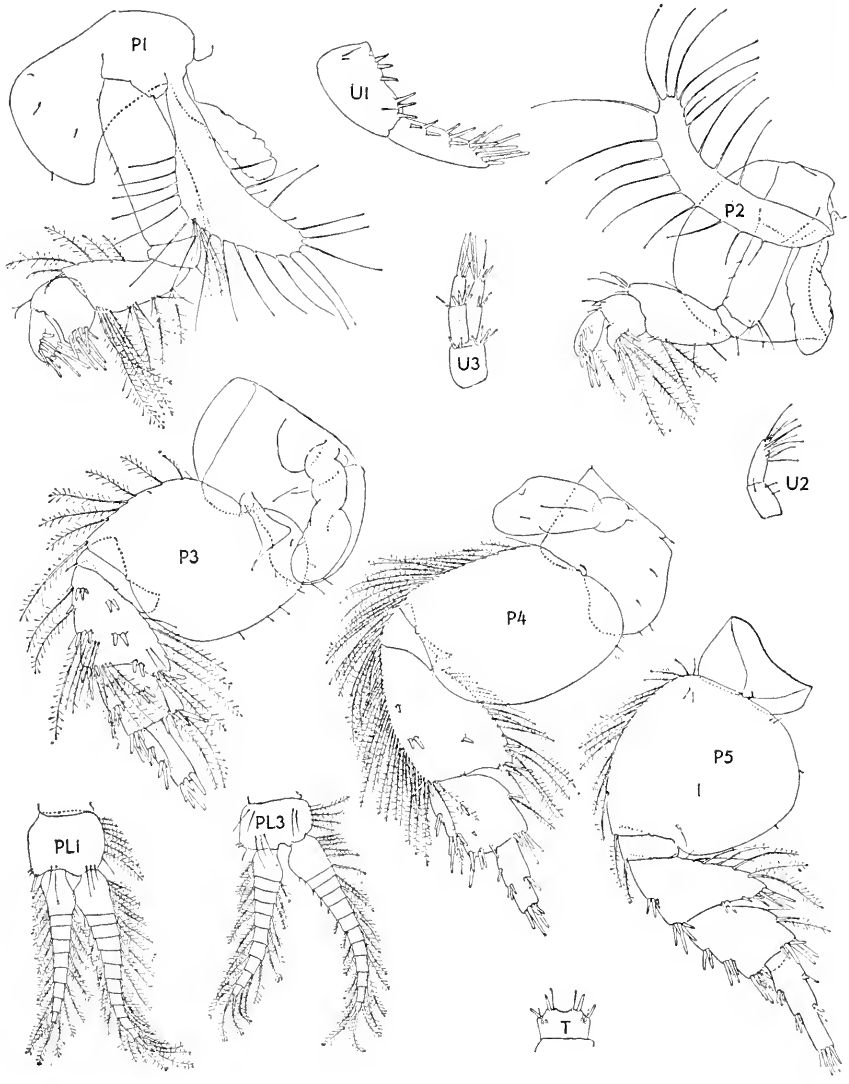

FIGURE 18.—*Neohaustorius schmitzi*, new species, ♀, 4.5 mm., holotype, Morehead City, N.C.

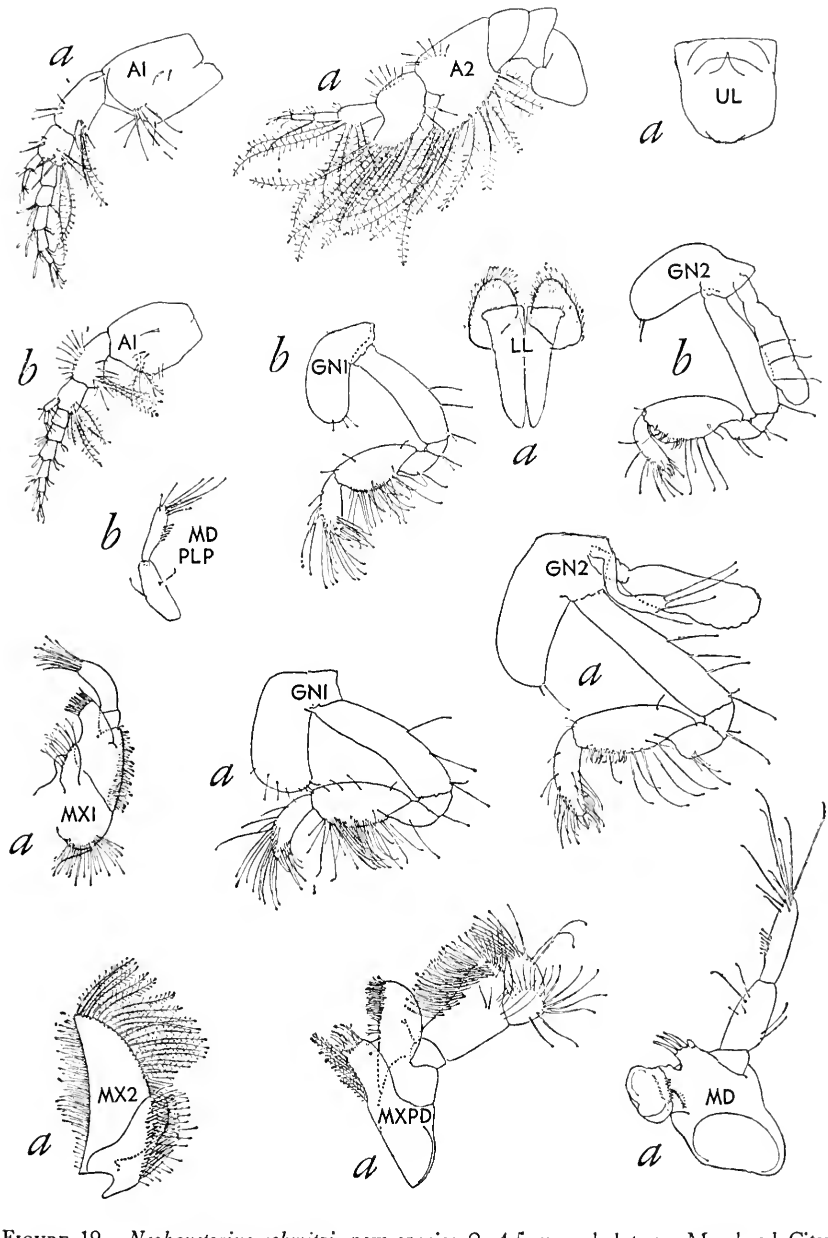

FIGURE 19.—*Neohaustorius schmitzi*, new species, ♀, 4.5 mm., holotype, Morehead City, N.C.; *a*, ♀, 4.5 mm., holotype; *b*, ♂, 3.5 mm., allotype.

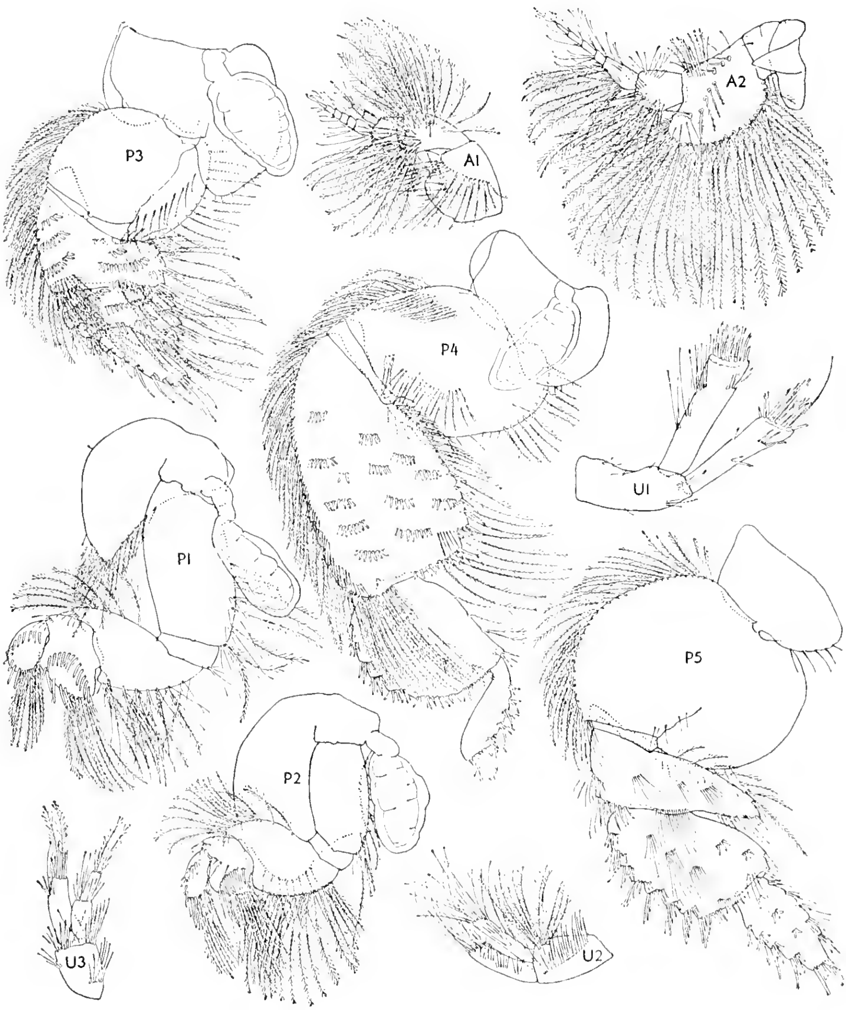

FIGURE 20.—*Pseudohaustorius borealis*, new species, ♂, 6.5 mm., holotype, off Cape Cod, Mass., *Albatross*-101, sta. 86.

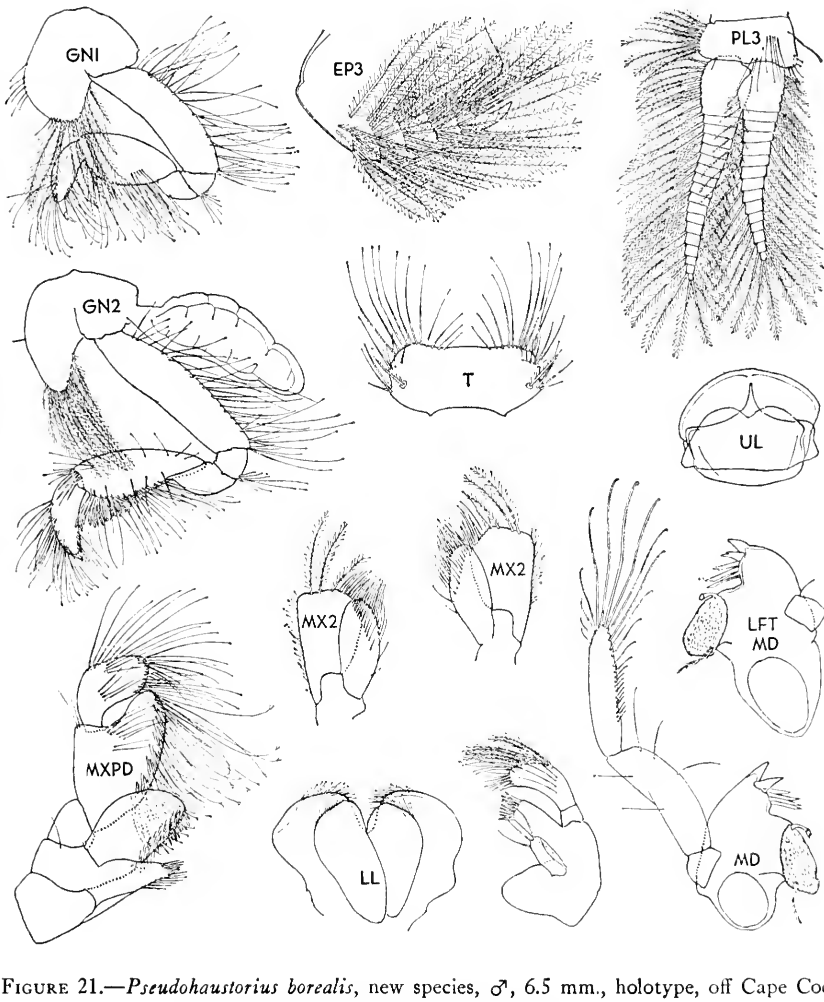

FIGURE 21.—*Pseudohaustorius borealis*, new species, ♂, 6.5 mm., holotype, off Cape Cod, Mass., *Albatross*-101, sta. 86.

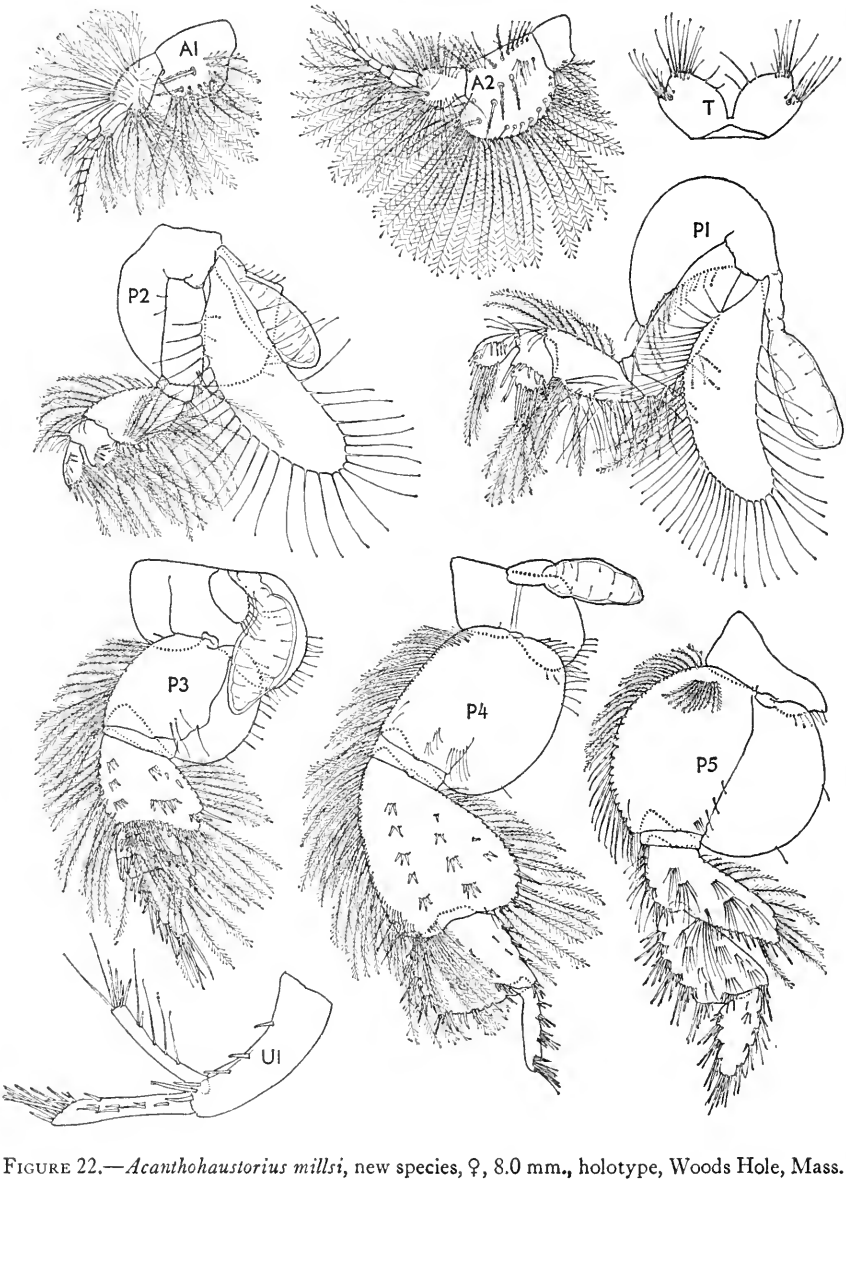

FIGURE 22.—*Acanthohaustorius millsi*, new species, ♀, 8.0 mm., holotype, Woods Hole, Mass.

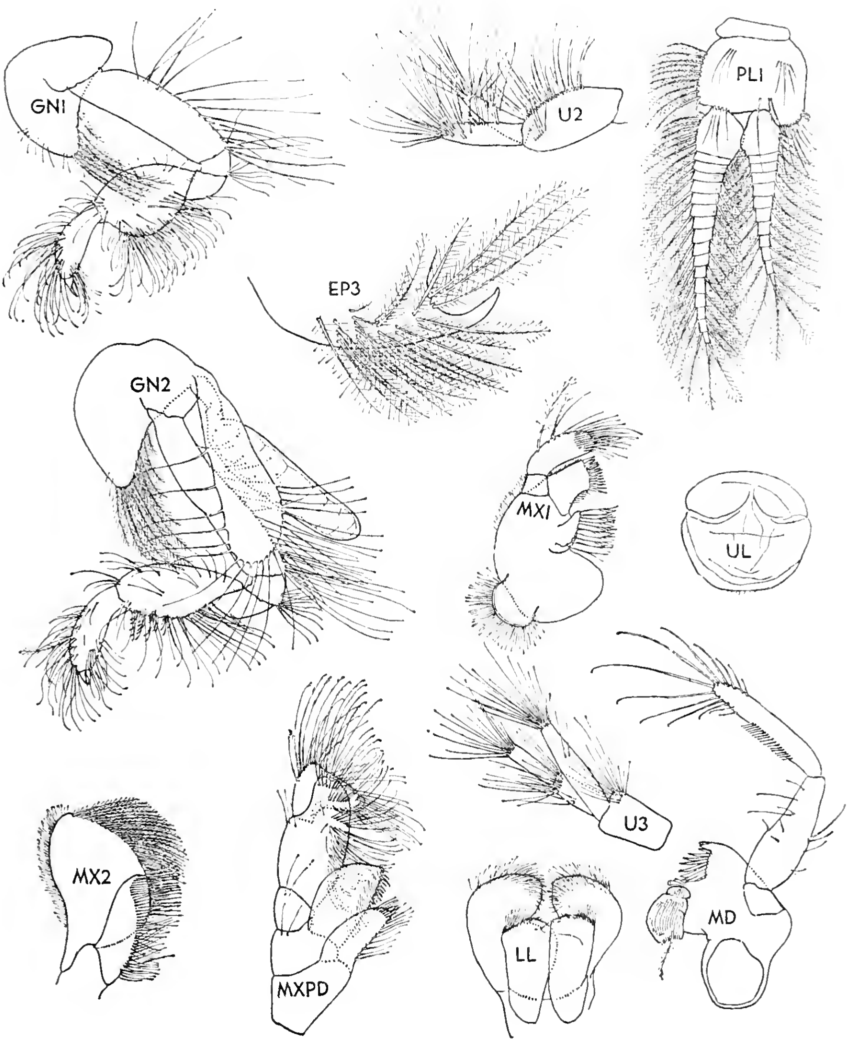

FIGURE 23.—*Acanthohaustorius millsi*, new species, ♀, 8.0 mm., holotype, Woods Hole, Mass.

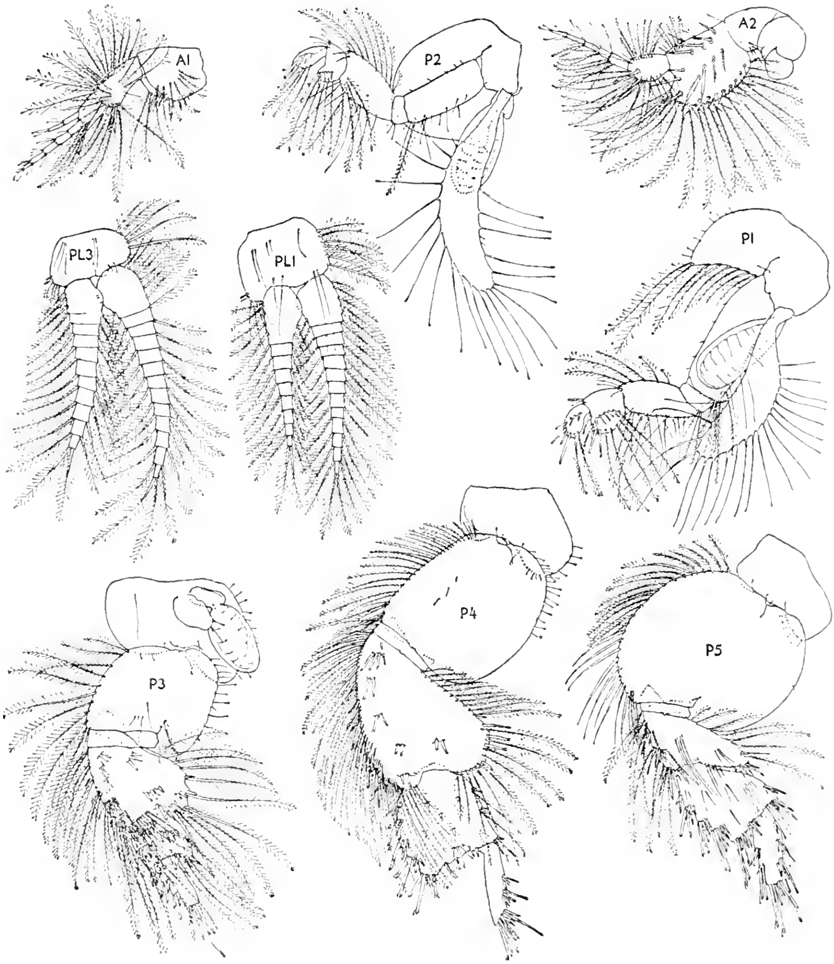

FIGURE 24.—*Acanthohaustorius intermedius*, new species, ♀, 4.5 mm., holotype, Barnstable Harbor, Mass.

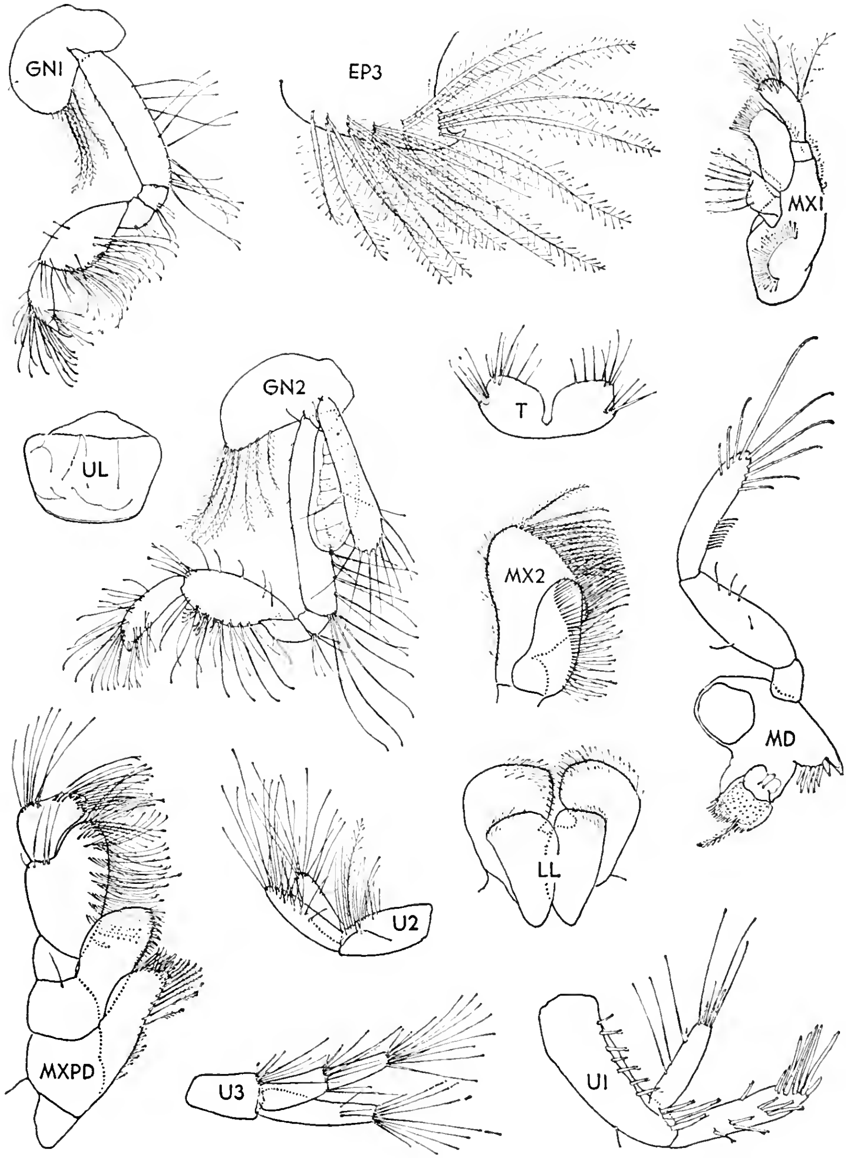

FIGURE 25.—*Acanthohaustorius intermedius*, new species, ♀, 4.5 mm., holotype, Barnstable Harbor, Mass.

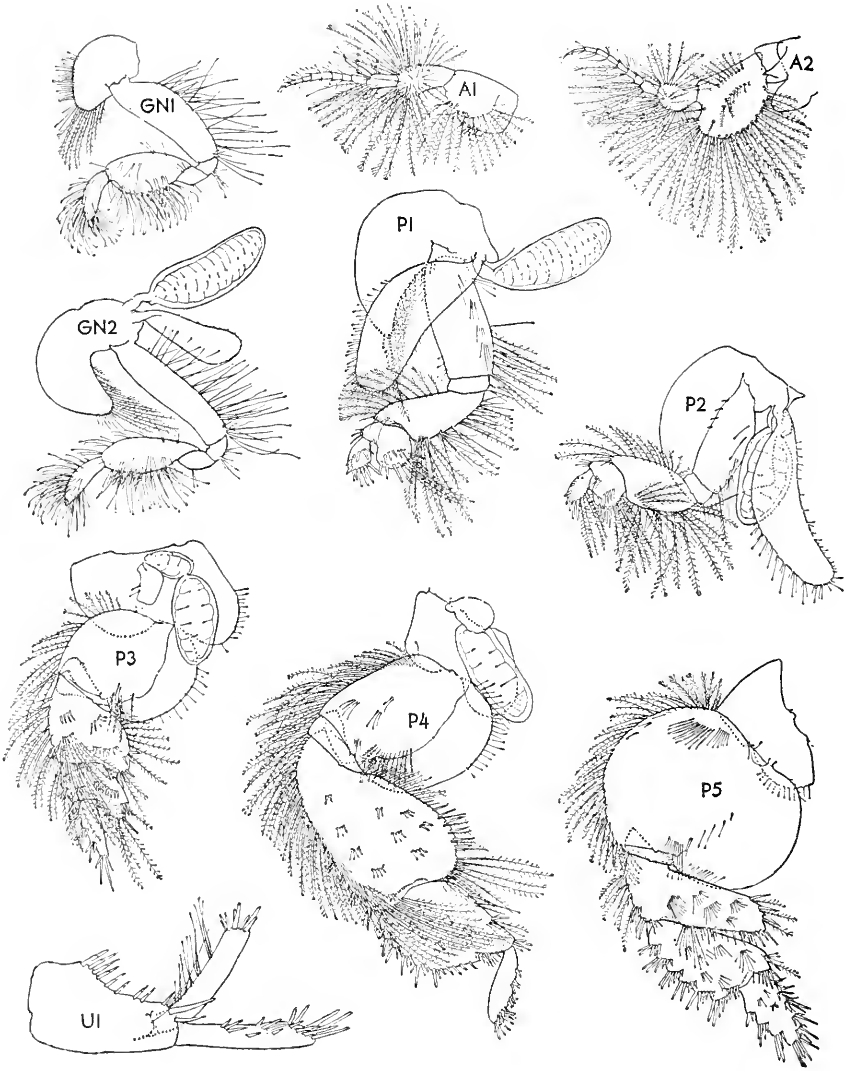

FIGURE 26.—*Acanthohaustorius spinosus* (Bousfield) 1962, ♀, 11.5 mm., holotype, Sandy Cove, N.B.

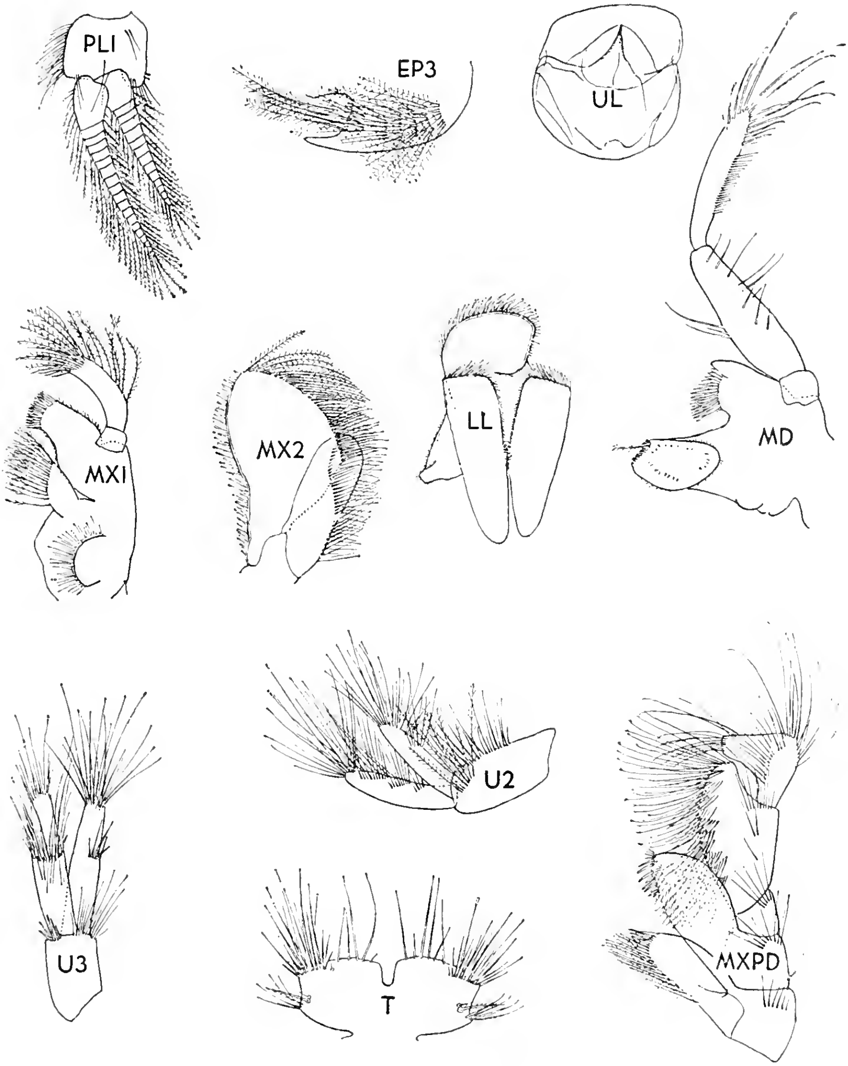

FIGURE 27.—*Acanthohaustorius spinosus* (Bousfield) 1962, ♀, 11.5 mm., holotype, Sandy Cove, N.B.

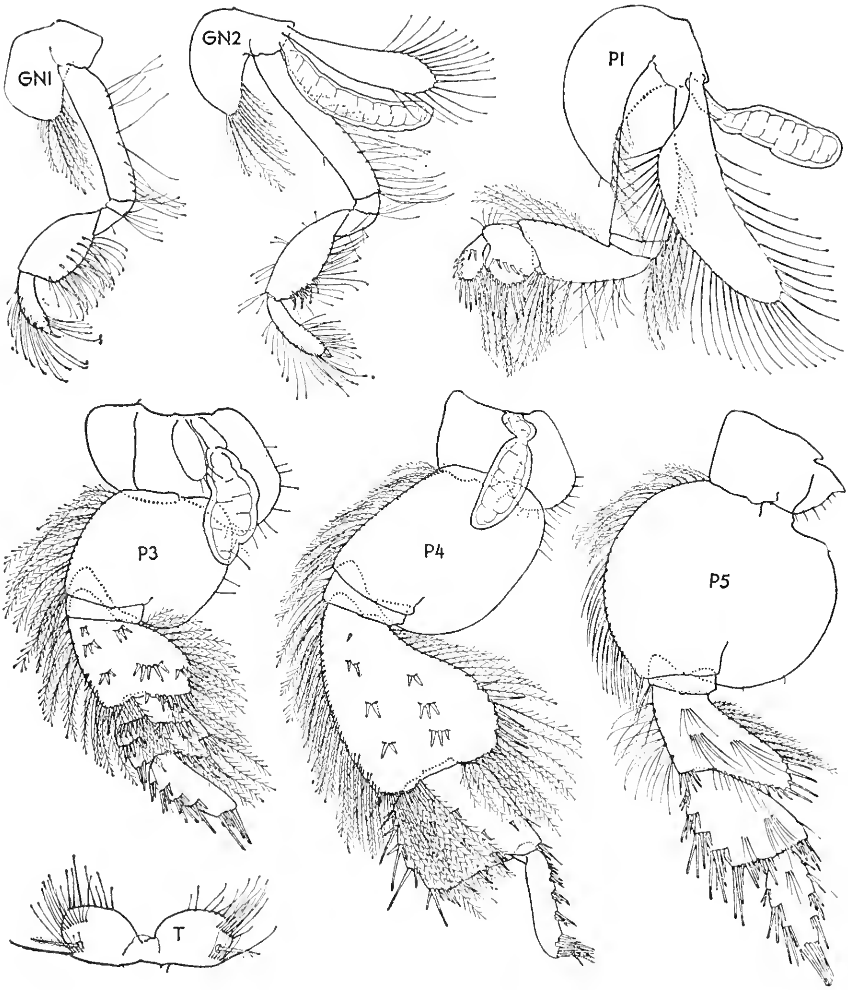

FIGURE 28.—*Acanthohaustorius shoemakeri*, new species, ♀, 8.5 mm., holotype, off Martha's Vineyard, Mass.

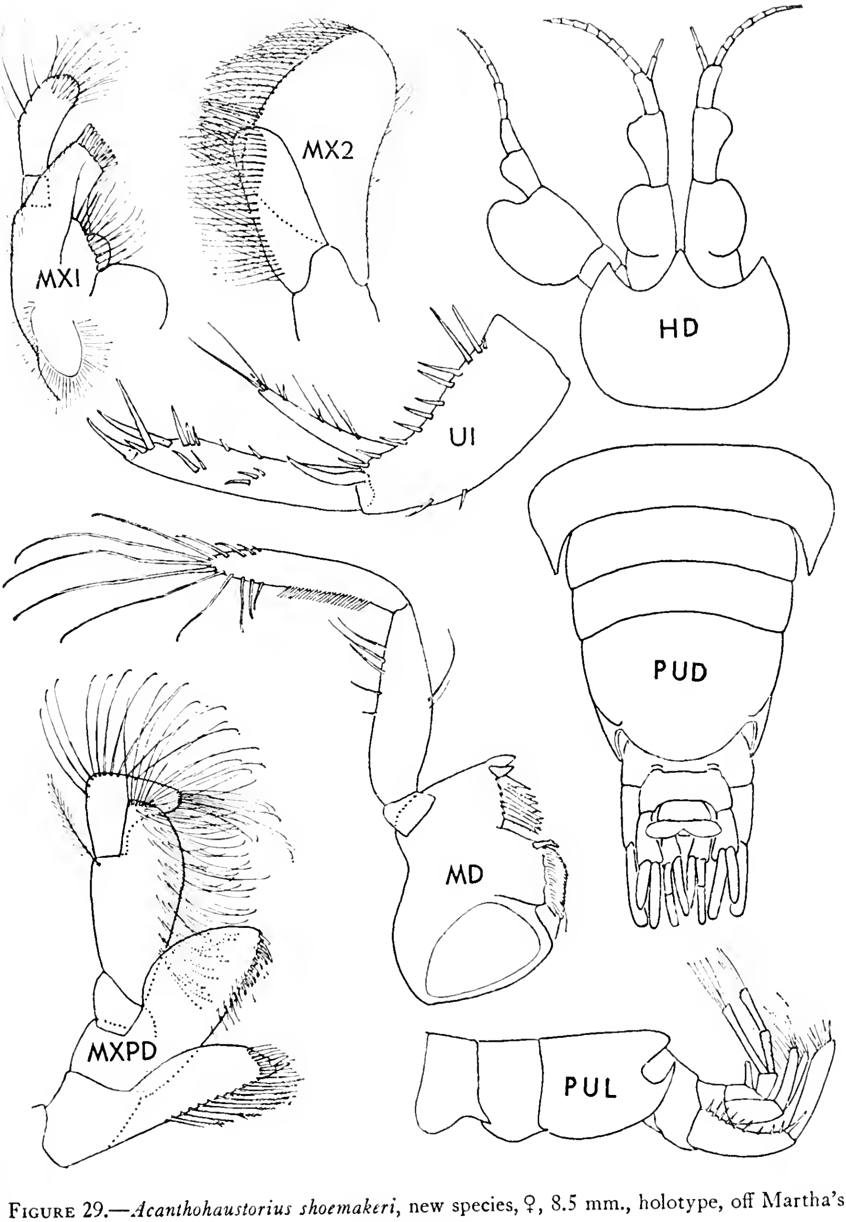

FIGURE 29.—*Acanthohaustorius shoemakeri*, new species, ♀, 8.5 mm., holotype, off Martha's Vineyard, Mass.

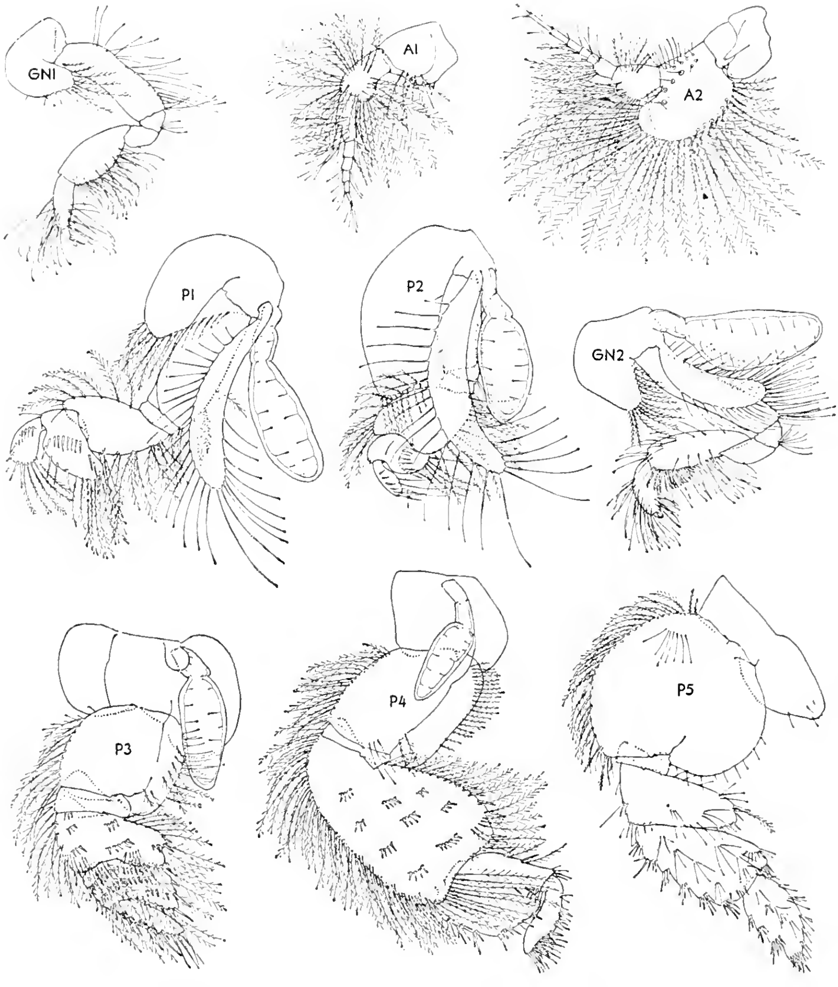

FIGURE 30.—*Pseudohaustorius caroliniensis*, new species, ♀, 8.0 mm., holotype, North Falmouth, Mass.

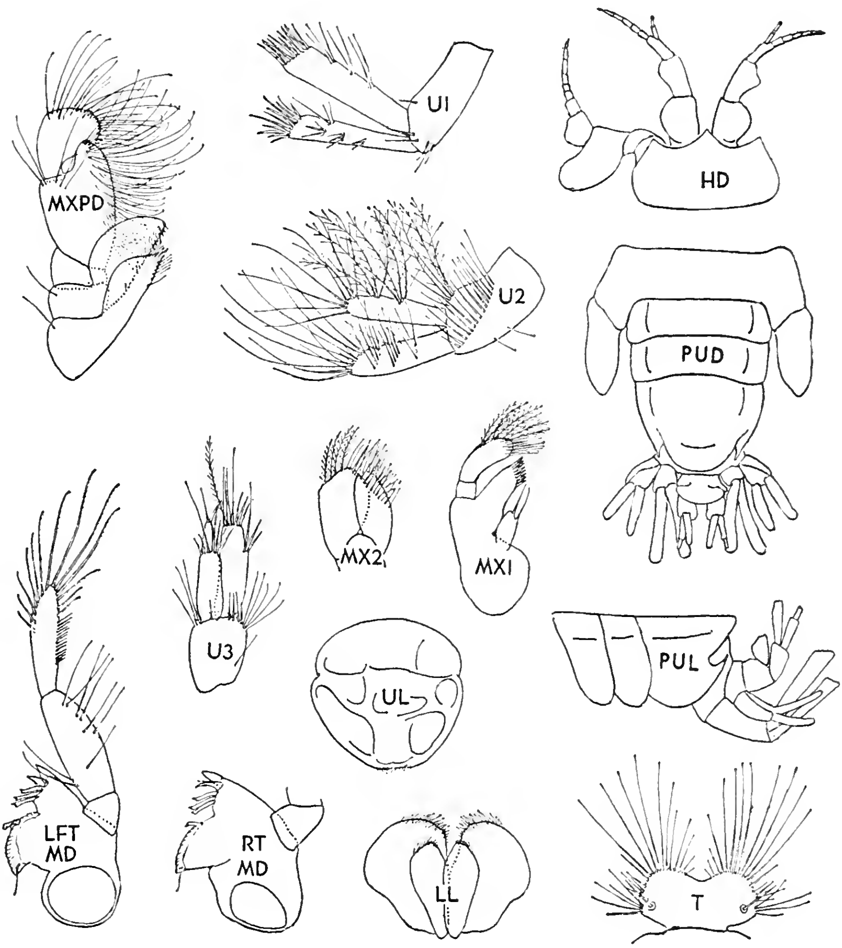

FIGURE 31.—*Pseudohaustorius caroliniensis*, new species, ♀, 8.0 mm., holotype, North Falmouth, Mass.

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PLANKTONIC COPEPODS FROM BAHÍA FOSFORESCENTE, PUERTO RICO, AND ADJACENT WATERS

By JUAN G. GONZÁLEZ AND THOMAS E. BOWMAN[1]

Beginning in the fall of 1957, an investigation of the plankton along the southwestern coast of Puerto Rico, from Bahía Montalva on the east to Posa de Don Eulalio on the west, was carried out by Dr. Robert E. Coker and Juan G. González. A map of the area showing the stations at which plankton samples were collected routinely for 2 years is given in figure 1. A description of the region, together with an account of the methods of collection and an analysis of the climatic and hydrographic conditions, is given by Coker and González (1960) in their ecological study of the copepod populations. The present paper is a taxonomic treatment of the planktonic copepods and is limited to the species that occur regularly in the bays and the inner

[1] González: Institute of Marine Biology, University of Puerto Rico, Mayagüez; Bowman: Associate Curator, Division of Crustacea, Smithsonian Institution.

part of the shelf. Offshore species that occasionally are carried into the inner shelf and bays are not included.

In the descriptions that follow we use the terms employed by Gooding (1957) for regions of the copepod body and the following abbreviations:

A1–A2	antennae 1–2
Md	mandible
Mx1–Mx2	maxillae 1–2
Mxp	maxilliped
P1–P5	swimming legs 1–5
Re, Re1–Re3	exopod, exopod segments 1–3
Ri, Ri1–Ri3	endopod, endopod segments 1–3
B1–B2	basipod segments 1–2
PedSeg 1–PedSeg 5	pedigerous segments 1–5

For most species the synonomies given are limited to those recording occurrences along the Atlantic coasts of North and South America. For a few species we have thought it useful to give full synonomies and more complete descriptions. Only western Atlantic distribution records are given in detail for widely distributed species.

This study was initiated by Dr. Robert E. Coker, and his advice and encouragement have been most helpful. Dr. Friedrick Kiefer kindly examined specimens of *Oithona hebes* for us and compared them with Brazilian specimens that he had earlier described, and Dr. Harry Yeatman read the section on *Longipedia helgolandica* and has permitted us to cite his records for this species.

Order Calanoida

Family Paracalanidae

Head and PedSeg 1, PedSegs 4 and 5 fused. Male head with small middorsal protuberance. Rostrum with 2 usually filiform appendages. Anal segment long. A1 23–25-segmented in female, with fewer segments in male. Ri of A2 longer than Re. Mouthparts reduced in male. Re of P1–P4 3-segmented, Ri of P1 2-segmented, Ri of P2–P4 3-segmented. Ri of P1–P4 often with spinules on posterior surfaces. Re3 of P1–P4 with 2 outer spines and 5 inner setae; terminal spine not serrate. Female P5 very small, sometimes absent, uniramose, composed of 2 short segments; left P5 of male 5-segmented, much longer than right.

Bernard (1958) removed *Calocalanus* from the Paracalanidae to

the new family Calocalanidae. Only 2 genera remain in the Paracalanidae, and they may be distinguished as follows:

Acrocalanus Giesbrecht	*Paracalanus* Boeck
Re2 of P2–P4 with spinulose outer margins	Outer margins smooth
Proximal part of outer margin of Re3 of P2–P4 less than twice as long as distal part	Proximal part nearly or more than twice as long as distal part
Female P5 absent	Female P5 2-segmented, distal segment with 2 unequal terminal setae

Two species of *Acrocalanus* occur in the Atlantic Ocean (Bowman, 1958), but both are oceanic species and are not found in the inshore waters of Puerto Rico. The 3 species of *Paracalanus* that occurred in our collections are considered below.

Key to Females of Local Species of *Paracalanus*

1. Very small species, usually less than 0.5 mm. long; rostral filaments thick and blunt; terminal setae of P5 short and stout . . . . . . **crassirostris**
   Larger species, usually more than 0.75 mm. long; rostral filaments filiform; medial terminal seta of P5 long and slender 2
2. A1 longer than body; B1 of P3–P4 without surface spinules . . . **aculeatus**
   A1 shorter than body; B1 of P3–P4 with surface spinules . . . . . **parvus**

In our collections, *P. crassirostris* is one of the 2 most common calanoids, especially in the bays. *P. parvus* is common, more consistently on the inner shelf than in the bays. *P. aculeatus* rarely occurs in inshore waters and may be characterized as an offshore species.

Paracalanus aculeatus Giesbrecht

FIGURES 2*a–e*

Paracalanus aculeatus Giesbrecht, 1888, p. 332; 1892, pp. 164, 169–170, pl. 9, figs. 20, 26, 30.—Dahl, 1894, pl. 21.—Cleve, 1900, pp. 78–80.—Farran, 1929, p. 222.—Davis, 1950, p. 93 (table).—Carvalho, 1952, pp. 142–143, pl. 1, figs. 11–12.—Wickstead, 1956, pp. 8–9.—Grice, 1960a, p. 220.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, p. 183.—Grice and Hart, 1962, p. 293.—Fish, 1962, pp. 10–11.—Björnberg, 1963, pp. 25–26.

FEMALE.—Length 1.02–1.08 mm. Prosome:urosome = 3.5–3.8. Head rather vaulted, rostral filaments filiform. Prosome without dorsal hump. Innermost caudal seta more than twice as long as caudal ramus. A1 longer than body. Third lobe of B1 of Mxp with 3 setae. P2–P4, B1 without surface spinules; Ri2 with prominent spinules on posterior surface. Re2 of P4 with row of rather broad, blunt, thin-walled spinules on posterior surface. Inner terminal spine of P5 2.5–3.0 times as long as outer terminal spine, considerably longer than distal segment.

MALE.—Not found in our collections.

DISTRIBUTION.—A circumtropical species. Along the Atlantic coast of the United States it is a common offshore species in waters south of Cape Hatteras (unpublished data from M/V *Theodore N. Gill* collections). North of Cape Hatteras it is present in the Gulf Stream (Cleve, 1900; Grice and Hart, 1962) but not in coastal or shelf water since it was not reported by Bigelow and Sears (1939), Deevey (1952a, 1952b, 1956, 1960), or Cronin, Daiber, and Hulbert (1962). In the South Atlantic it occurs south of the latitude of Rio de Janeiro (Farran, 1929; Björnberg, 1963). Cleve (1900) recorded it from several localities along South America between Trinidad and French Guiana. Throughout its range it is found typically in offshore rather than coastal waters. In the Puerto Rican collections it is very rare in inshore waters, but fairly common offshore.

Paracalanus crassirostris F. Dahl

FIGURES 2*f–n*, 3*a*

Paracalanus crassirostris F. Dahl, 1894a, p. 12, pl. 1, figs. 27, 28—Thompson and Scott, 1903, p. 243.—Giesbrecht and Schmeil, 1898, p. 24.—Sewell, 1929, pp. 72–76, fig. 27.—Pesta, 1916, p. 4.—Gurney, 1927, pp. 144–147, figs. 16B–D, 17A–E.—Deevey, 1948, pp. 21–22; 1952a, p. 92; 1952b, p. 144, fig. 13; 1956, p. 134; 1960, p. 29.—Davis, 1950, p. 93 (table).—Davis and Williams, 1950, pp. 521, 523 (tables).—Grice, 1956, p. 62 (ftn.); 1960a, p. 223.—Breuer, 1962, p. 167.—Jeffries, 1962, passim.—Björnberg, 1963, p. 28.—Cuzon du Rest, 1963, passim.

Paracalanus crassirostris f. *typica* Früchtl, 1923, p. 456; 1924, pp. 36–39.

FEMALE.—Length 0.47–0.50 mm. Prosome:urosome = 3.2–3.5. Head rather low; forehead somewhat produced; rostral filaments thick and blunt, not filiform. Innermost caudal seta more than twice as long as caudal ramus. A1 nearly as long as body. Third lobe of B1 of Mxp with 2 setae. P2–P4 as in figures 2*j–l*; surface armature poorly developed; no surface spinules on B1 and B2. P5 short; terminal setae short and stout.

MALE.—Length 0.35–0.37 mm. Prosome:urosome = 3.2. Prosome relatively shorter than in female; forehead less produced; rostrum triangular. A1 about as long as prosome, with fewer segments than in female. P1–P4 as in female. P5 with short terminal setae.

DISTRIBUTION.—Mouth of Tocantin River, Brazil (Dahl); Brazil coast (Björnberg); Indian Ocean, several localities (Früchtl, Sewell, Thompson and Scott); Suez Canal (Gurney); Tisbury Great Pond, Martha's Vineyard; Long Island Sound; Delaware Bay (Deevey); Raritan Bay (Jeffries); Florida coast (Davis, Davis and Williams, Grice); Louisiana (Cuzon du Rest). The species appears to be limited mainly to tropical and subtropical coastal waters, frequently in

brackish water. It is widespread in coastal waters of the Indian Ocean but has not been found in the coastal waters of Japan although the latter have been thoroughly investigated (summary in Yamazi, 1956). It has not been reported from the Mediterranean or eastern Atlantic.

Collections made during the 1959 and 1960 Smithsonian-Bredin Expeditions indicate that *P. crassirostris* is probably widespread in suitable inshore localities in the Caribbean. Specimens were collected at the following localities: Man of War Bay, Tobago; Marigot Bay and Castries Harbor, Saint Lucia; Progresso, Yucatan.

REMARKS.—The minute size, blunt rostral filaments, and short terminal setae of P5 will serve to identify *P. crassirostris*. Davis (1944) described *P. c.* var. *nudus* from Chesapeake Bay, characterized as follows:

1. Surface armature of P1–P4 reduced, limited to Ri2 of P3 and P4, which are similar to Ri2 of the Puerto Rican specimens.
2. Last 2 segments of A1 equal in length. The validity of this criterion is doubtful since it appears from the arrangement of the setae that the narrow terminal segment is missing in Davis' drawing (pl. 1, fig. 5) although this segment is shown in his lateral view of the female (pl. 1, fig. 4). A1 has 24 segments in both drawings, but in figure 5 the long basal segment is shown as divided into 2 segments. In Puerto Rican specimens the basal segment usually is not divided, but a suture is occasionally present, in which case A1 is 25-segmented.
3. The terminal segment of P5 is relatively long.

Puerto Rican specimens show more resemblance to those described by Gurney (1927) from the Suez Canal than to Davis' *P. c.* var. *nudus*. Specimens examined from off Cape Kennedy, Fla., are indistinguishable from Puerto Rican specimens. Deevey's (1948) specimens from Tisbury Great Pond agreed in all respects with Gurney's description and not with *P. c.* var. *nudus*.

***Paracalanus parvus* (Claus)**

FIGURES 3*b–i*

Calanus parvus Claus, 1863, pp. 173–174, pl. 26, figs. 10–14; pl. 27, figs. 1–4.

Paracalanus parvus (Claus).—Boeck, 1865, pp. 232–233.—Cleve, 1900, pp. 80–81.—Farran, 1929, pp. 221–222.—Wilson, 1932a, p. 26; 1932b, pp. 38–39, fig. 21.—Vervoort, 1946, pp. 130–132 [literature and synonomy].—Bigelow and Sears, 1938, pp. 336–337, fig. 34.—Oliveira, 1945, p. 455, pl. 3, fig. 5; pl. 4, figs. 3–6; 1947, p. 459, fig. 8.—Carvalho, 1945, pp. 93–94, pl. 7, fig. 4; 1952, pp. 143–144, pl. 1, figs. 13–14.—Sutcliffe, 1948, p. 235.—Davis, 1950, p. 204 (table).—King, 1950, p. 128 (table).—Deevey, 1952a, p. 92; 1952b, pp. 142–144, fig. 13; 1960, p. 29, figs. 8, 11.—Grice, 1956, pp. 62–64; 1960, p. 223; 1962a, p. 287, passim.—Woodmansee, 1958, pp. 253–254.—Légaré,

1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cronin, Daiber, and Hulbert, 1962, p. 87.—Björnberg, 1963, pp. 27–28.—Reeve, 1964, passim.

Scolecithrix ancorarum Oliveira, 1947, pp. 460–461, pl. 3, figs. 1–8.

Female.—Length 0.73–0.93 mm. Prosome:urosome = 2.8–3.2. Head moderately high, rostral filaments filiform. Prosome usually with distinct dorsal hump in region of Mx1. Innermost caudal setae only half as long as caudal ramus. A1 nearly as long as body. Third lobe of B1 of Mxp with 2 setae. B1 of P3 and P4 with lateral rows of spinules and surface spinules as shown in figure. Inner terminal spine of P5 5–6 times as long as outer terminal spine, only a little longer than distal segment.

Male.—Length 0.76–0.78 mm. Prosome:urosome = 2.3–2.5. Head not as flat as in female. Spinules on B1 of P3 and P4 reduced or missing. P5 as in figure 3*i*.

Distribution.—Worldwide, in tropical, temperate, and sometimes Arctic seas, usually in coastal waters.

Oliveira's (1947) *Scolecithrix ancorarum* is obviously a *Paracalanus*. The size (1 mm.) and thin rostral filaments rule out *P. crassirostris*. The short antennae and the presence of spinules on B1 of P4 place it in *P. parvus* rather than *P. aculeatus*.

Family Pseudocalanidae

Small calanoids, head and PedSeg 1 (at least in female), PedSegs 4 and 5 fused. Innermost and outermost caudal setae very short, 4 subequal terminal setae. A1 24-segmented in female, with fewer segments in male. Re of A2 longer than Ri. Mouthparts reduced in male. Re of P1–P4 3-segmented, Ri of P1 1-segmented, Ri of P2 2-segmented, Ri of P3–P4 3-segmented. Re3 of P2–P4 with 3 outer spines and 4 inner setae, terminal spine serrate. Female P5 very small or absent, uniramose, composed of 2–3 short segments; right male P5 5-segmented, left P5 shorter.

Genus *Clausocalanus* Giesbrecht

Rostral filaments spiniform in female, atrophied in male. B2 of P2 and P3 very wide, distal margin dentate. Female P5 3-segmented, without setae, distal segment bifurcate at tip. Male left P5 long, 5-segmented, right P5 minute, 1–3-segmented.

Clausocalanus furcatus (Brady)

Figures 3*j*–*k*, 4*a*

Drepanopus furcatus Brady, 1883, pp. 77–78, pl. 4, figs. 1, 2; pl. 24, figs. 12–15.

Clausocalanus furcatus (Brady).—Giesbrecht, 1888, p. 334; 1892, pp. 186–194, pl. 36, figs. 32, 33, 35.—Dahl, 1894, p. 12.—Cleve, 1900, pp. 56–57.—Farran, 1929, pp. 225–226.—Davis, 1950, p. 92 (table).—Wilson, 1950, p. 190.—

Carvalho, 1952, p. 144, pl. 1, figs. 15–17.—Wickstead, 1956, pp. 10–11.—Grice, 1960, p. 220.—Grice and Hart, 1962, passim.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, pp. 183–184.—Björnberg, 1963, pp. 31–33, fig. 16.

Female.—Length 1.1–1.6 mm. Prosome:urosome = about 2.5. Head not vaulted, rostral filaments very slightly curved posteriad. Genital segment shorter than 2d or 3d urosome segments; spermathecae highly refractile and conspicuous. Caudal rami nearly twice as long as broad. A1 segments 4, 6, 8, 18, and 22 each with 1 aesthete.

Male.—Length 1.1–1.2 mm. Urosome segment 2 shorter than segments 3 and 4 combined. Left P5 unisegmental.

Distribution.—Worldwide in warm waters. In the western Atlantic it has been found from south of Montauk Point, Long Island (40°44′ N., 71°41′ W., Grice and Hart, 1962) to off Mar del Plata, Argentina (Farran, 1929). It is an oceanic species, found only rarely in our collections.

Family Centropagidae

None of prosome segments fused. Female A1 24–25-segmented; one of male A1 prehensile. Male mouthparts not reduced. Re and Ri of P1–P4 3-segmented in marine genera. Female P5 biramous, natatory, right Re2 produced mediad into strong spine. Male P5 biramous, Ri well developed and bearing setae, right P5 stronger.

Genus *Centropages* Krøyer

Urosome 3-segmented, genital segment often asymmetrical. A1 24-segmented. Re of A2 longer than Ri. Distal setae of Mx2 long, robust, sparsely armed with setules. Re3 of P4 with 3 outer spines. Re of left male P5 2-segmented; Re of right male P5 3-segmented, Re2 and Re3 together forming a claw.

Centropages furcatus (Dana)

Figures 4*b*–*g*

Catopia furcata Dana, 1849, p. 25; 1852, pp. 1173–1174, pl. 79, figs. 1a–d.

Centropages furcatus (Dana).—Cleve, 1900, p. 52.—Foster, 1904, p. 73.—Farran, 1929, p. 255.—Bigelow and Sears, 1939, p. 345 [*furcata*].—Wilson, 1942, p. 177; 1950, pp. 186–187.—Carvalho, 1945, p. 95, pl. 7, fig. 6; 1952, p. 145.—Davis, 1950, p. 92 (table).—King, 1950, p. 128 (table).—Wickstead, 1956, p. 12.—Grice, 1956, pp. 52–53; 1960, p. 224.—Grice and Hart, 1962b.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, p. 184.—Fish, 1962, p. 15.—Björnberg, 1963, pp. 42–43, fig. 23.

Manaia vilificata Oliveira, 1947, pp. 466–467, fig. 10 (text), pl. 6, figs. 1–9.

Female.—Length 1.6–1.7 mm. Prosome rather narrow. Ventral eye strongly produced. PedSeg 5 symmetrical, produced on either

side into long point; on rounded medial to each point is shorter spine. Genital segment produced into triangular lobes on either side and into rounded ventral lobe on right side. Anal segment twice as long as preceding segment. Right caudal ramus very slightly longer and wider than left. A1 slightly longer than body; anterior margins of segments 1, 2, and 5 produced into sharp teeth. P5 as in figures 4*e–f*.

MALE.—Length 1.2–1.3 mm. Segments 15–16 of prehensile antenna with very small teeth on anterior margin. P5 as in figure 4*g*.

DISTRIBUTION.—Circumtropical. In the western Atlantic from the Gulf Stream offshore from Chesapeake Bay (Grice, 1962a, 1962b, station II) to the south of Rio de Janeiro. It is rare in the area of the Puerto Rican study but is common farther offshore. On the 1959 Smithsonian-Bredin Expedition it was collected at Man of War Bay, Tobago; Marigot Bay, Saint Lucia; and Prince Rupert Bay, Dominica. Oliveira's (1947) *Manaia velificata* is clearly an immature *Centropages furcatus*.

Family Temoridae

Head and PedSeg 1 separate, PedSegs 4 and 5 fused or free. Urosome 3-(rarely 4-)segmented in female, 5-segmented in male. A1 24–25-segmented; right A1 of male prehensile. Ri of P1–P4 with less than 3 segments. P5 uniramous in both sexes.

Genus *Temora* Baird

Body short and compact; head much higher than posterior prosome. PedSegs 4 and 5 fused. Female urosome 3-segmented. Head with 2 delicate rostral filaments. Caudal rami long and narrow, sometimes asymmetrical. A1 24-segmented. Ri of A2 7-segmented, only slightly longer than Re. Re of P1–P4 3-segmented; Ri 2-segmented. Female P5 3-segmented. Male P5 very asymmetrical; left P5 longer, 4-segmented, Ri represented by medial process of B2 forming chela with 4th segment; right P5 3-segmented.

Temora stylifera (Dana)

FIGURES 4*h–k*

Calanus stylifera Dana, 1849, p. 13.

Temora stylifera (Dana).—Giesbrecht, 1892, pp. 328–338, pl. 17, figs. 1, 2, 4–13, 19, 22; pl. 38, figs. 26, 29.—Dahl, 1894, p. 12.—Cleve, 1900, p. 88.—Farran 1929, pp. 257–258.—Wilson, 1932b, p. 104, fig. 69; 1942, p. 209; 1950, p. 343, pl. 34, fig. 526.—Bigelow and Sears, 1939, p. 345.—Carvalho, 1945, p. 97, pl. 8, figs. 9a–c; 1952, pp. 147–148, pl. 1, figs. 28–32.—Oliveira, 1945, p. 455.—Davis, 1950, p. 94 (table).—King, 1950, p. 128 (table).—Deevey, 1952a, p. 90; 1952b, pp. 131 (table), 147; 1960, p. 33.—Grice, 1960a, p. 220

(table).—Grice and Hart, 1962a, passim; 1962b.—Wickstead, 1956, pp. 13–14.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigon, 1962, p. 184.—Fish, 1962, pp. 15–16.—Björnberg, 1963, pp. 46–48, fig. 25.

Female.—Length 1.4–1.9 mm. Posterior corners of PedSeg 5 produced into long, ventrally curving points. Caudal rami symmetrical. Caudal setae nearly as long as rami; left next-to-innermost seta longer than right. B1 of P1 with inner seta. Medial spine of P5 much longer than apical spines.

Male.—Length 1.4–1.6 mm. Prehensile A1 with combs of spinules on segments 17-19. Re of left P2 2-segmented, of right P2 3-segmented. Terminal segment of left P5 very broad.

Distribution.—Although it has been taken near Cape Sable, Nova Scotia (Bigelow, 1926, p. 307), *T. stylifera* is not common north of Delaware Bay. It is abundant in coastal waters south of Cape Hatteras and in the Gulf of Mexico. It is widespread in the Caribbean and along the coast of South America at least as far south as Guaratúba Bay, Brazil (Carvalho, 1945; Björnberg, 1963). In our collections it was taken occasionally in the shelf area but not in the bays.

Remarks.—PedSeg 5 is pointed in only 2 species of *Temora*, *T. stylifera* and *T. discaudata*, and the latter species is distinguished readily by its asymmetrical caudal rami. Moreover, the 2 species are probably allopatric, with *T. stylifera* limited to the Atlantic and *T. discaudata* to the Indo-Pacific. Pacific records of *T. stylifera* given by Wilson (1942, 1950) are erroneous; all Pacific specimens in the U.S. National Museum identified by Wilson as *T. stylifera* are actually *T. discaudata*. Other Pacific accounts of *T. stylifera* are either unillustrated records in faunal works or misidentifications. Mori's (1937) illustrations of *T. stylifera* are of an immature female because the posterior corners of the cephalosome are produced into points and the distal segment of P5 is shorter than in the adult. Undoubtedly the symmetrical anal segment and caudal rami led Mori to misidentify this immature *T. discaudata*.

Chiba (1953a) described the male *T. stylifera* from the Sea of Japan, but his drawing of P5 clearly places his specimens in *T. discaudata*. Later in the same year (1953b) he again described the male *T. stylifera*, but the specimen illustrated was immature, with short caudal rami and incompletely developed P5, and was doubtless a young *T. discaudata*.

Temora turbinata (Dana)

Figures 5*a–e*

Calanus turbinatus Dana, 1849, p. 12.

Temora turbinata (Dana).—Giesbrecht, 1892, pp. 329, 336–338, pl. 17, figs. 14, 17, 18, 21; pl. 38, fig. 27.—Cleve, 1900, p. 88.—Wilson, 1932a, p. 33;

1932b, pp. 106–107, fig. 71.—Sutcliffe, 1948, p. 235.—Davis, 1950, p. 94 (table).—King, 1950, p. 128 (table).—Deevey, 1952a, p. 90; 1952b, p. 131 (table); 1960, p. 16 (table).—Grice, 1956, pp. 66–67; 1960a, p. 223.—Grice and Hart, 1962b.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, p. 184.—Reeve, 1964, passim.

Female.—Length 1.1-1.3 mm. Posterior corners of PedSeg 5 rounded. Anal segment shorter than preceding segment, slightly asymmetrical. Right caudal ramus slightly longer than left, next-to-innermost caudal setae swollen at base, especially the right seta. P5 as in figure 5*d*.

Male.—Length 1.0-1.2 mm. Anal segment asymmetrical, longer on left side. P5 as in figure 5*e*.

Distribution.—On the east coast of the United States north of Cape Hatteras it is uncommon and is listed usually as a stray from the south. The most northern record appears to be that of Bigelow (1926, p. 293) from the Gulf of Maine. It is common in coastal waters south of Cape Hatteras (unpublished observations) and in the Gulf of Mexico.

On Smithsonian-Bredin Expeditions it was collected at Castries Harbor, Saint Lucia, and at Mujeres Harbor, Quintana Roo, Yucatan, Mexico. In the Puerto Rico collections, *T. turbinata* was found only rarely in the bays but was fairly common in the shelf area, where it was taken much more frequently than *T. stylifera*.

Remarks.—*T. longicornis*, which replaces *T. turbinata* north of Cape Hatteras, is similar but can be distinguished easily by the long anal segment and symmetrical caudal rami.

Family Pseudodiaptomidae

Head and PedSeg 1 fused or separate. Urosome of 3-4 segments in female, 5 segments in male; female caudal ramus at least 2.5 times as long as broad. Female A1 20–22-segmented; right male A1 prehensible, with reduced number of segments. Re and Ri of P1–P4 3-segmented. Female P5 non-natatory, without Ri, Re 2-segmented. Right male P5 without Ri, Re 2–3-segmented with terminal hook; Ri of left P5 present or absent, Re 2–3-segmented.

Genus *Pseudodiaptomus* Herrick

Female P5 without spines or processes on inner margin of Re1. B2 of left male P5 without long curved process on inner margin.

Pseudodiaptomus cokeri, new species

Figures 6–9

Female.—Length 1.35–1.50 mm. In dorsal view prosome (0.97–1.02) 1.7–1.9 times as long as urosome (0.52–0.59). Head fused with

PedSeg 1; PedSegs 4 and 5 separate; PedSeg 5 very short and narrower than other segments. Forehead rather strongly convex. Posterior margins of PedSegs 2, 3, and 4 serrate laterally; serrations extend dorsally on PedSeg 4. Posterior corners of PedSeg 5 rounded, each armed posteriorly with a group of long, fine hairs and a number of shorter, fine hairs. Urosome 3-segmented. Genital segment strongly produced ventrally; genital operculum conspicuous, bearing a few setules on posterior margin; posterior part of segment produced dorsally into lobe; segment armed with groups of spines and setae as shown in figures 6*a–c*. Middle part of segment 2 produced dorsally into hump bearing 2 platelike lobes; right lobe more conspicuous and more elevated. Caudal rami long and narrow, about 7 times as long as wide; left ramus a little longer than right; medial margins bearing long setules; distal halves of lateral margins with shorter setules.

A1 reaching slightly beyond posterior margin of genital segment, 21-segmented. Ri1 of A2 with 4 dentate spines on lateral margin. Md palp with 4-segmented Re and 2-segmented Ri; gnathal lobe with 9 teeth. Mx1 and Mx2 normal; setal armature as shown in figures 7*a* and 9. Mxp with Ri of 4 segments; segments 1–3 with peculiar bifurcate setae.

P1–P4 with armature of spines and setae characteristic of the genus and surface spinules as in figures 6*d–f*, 7*b–c*. P5 symmetrical. B2 with a few spinules on distolateral corner. Re 2-segmented; distal margin of Re1 produced into rounded lobe, proximal to which is slender spine on lateral margin, a row of spinules on anterior surface, and sometimes a row of spinules on medial margin. Re2 very similar to that of *P. coronatus;* shorter medial branch of bifurcate terminal spine about as long as or slightly shorter than setose mediodistal process.

Egg sacs subequal, left sac slightly larger than right.

Male.—Much smaller than female, length 0.93–1.0 mm. In lateral view prosome (0.67–0.72) about 2.3 times as long as urosome (0.27–0.33 mm). Serrations on posterior margins of PedSegs 3 and 4 present or absent, sometimes present on PedSeg 3 but not on PedSeg 4. Posterior margin of PedSeg 5 without setae. Posterior margins of urosome segments 2–4 armed with dentate spines; spines narrow and closely spaced on ventral surface, becoming broader and more widely separate laterad and dorsad. Urosome segment 2 without spines dorsally, with V-shaped group of slender spines on ventral surface slightly posterior to middle of segment, apex of V anteriad.

Urosome segment 3 sometimes with smaller transverse row of spines at about middle of ventral surface. Caudal rami about twice as long as wide, with fine hairs on medial margins but not on lateral margins.

A1 reaching about to posterior margin of urosome segment 2. Left A1 21-segmented, like that of female but with larger aesthetascs. Right A1 19-segmented; geniculation between segments 17 and 18; segment 3 bearing 3 very long setae; segments 4–7 very short; segment 9 with long, heavily chitinized spine; segments 10–11, 13–16, and 18 with shorter spines. Segment 17 with dentate lamella on anterior margin; segment 18 with partial suture near proximal end; segment 19 the longest.

Mouthparts and P1–P4 as in female. Right P5 slightly shorter than left. B1 with 4–5 stout spines on medial margin. B2 about 1.6 times as long as wide; proximal part of medial margin with row of 4 spines posterior to which is brush of spinules; lateral margin with a few well-separated spinules. Re1 wider than long; medial margin bearing slender seta with globular base, produced distally into rounded lobe bordered with spinules; anterior part of distal margin spinulose, posterior part with strong lateral spine and peculiar bilobed appendage; inner lobe of appendage longer, distally spinose; outer lobe bearing curved setule at apex. Re2 about as wide as long; medial margin produced in middle, where it bears a seta with angular process at base; lateral margin evenly rounded, with spine at distolateral corner. Claw slightly longer than Re2, strongly curved, produced at base into bilobed process bearing seta on each lobe.

B1 of left P5 slightly longer than wide; inner margin strongly convex, armed with 2–3 heavy dentate spines; anterior surface with row of 4 spines near distal margin. B2 elongate; medial margin armed along most of length with brush of about 3 rows of spinules; posterior surface with curved row of spinules bounded proximally by slender seta; lateral margin with a few widely spaced setae. Lateral margin of Re1 with spine near distal end and seta proximal to spine; medial margin with seta at distal end. Re2 with acute apex bearing minute seta; near apex are 1 lateral seta and 3 medial setae arranged as shown in figures 7*h–i*; most proximal medial seta very small and in some views hidden by larger seta distal to it. Ri about .75 as long as Re; apex and distal .4 of medial margin spinulose.

Color.—Without pigment except for pairs of red spots on dorsal surface, indicated by stippling in figure 6*a*; a pair at the anterior margin of PedSeg 2, a pair in the middle of PedSeg 4, and pairs on the posterior parts of the genital segment and urosome segment 2.

Types.—Holotype, female, USNM 107790; allotype, male, USMN 107791; and 187 paratypes (46 females, 63 males, 78 copepodids), from Bahía Fosforescente, Puerto Rico, collected Apr. 13, 1957.

Distribution.—In the Puerto Rico collections, *P. cokeri* was taken only in Bahía Fosforescente. It was collected at Marigot Bay and Castries Harbor, St. Lucia, and at St. Johns, Antigua, by Smithsonian-

Bredin Expeditions and at Oyster Bay, Falmouth, Jamaica, by W. S. Glidden of the U.S. Navy Oceanographic Office. All these collections were made at night, indicating that *P. cokeri* lives on or near the bottom during the day. Jacobs (1961) observed that *P. coronatus* is not truly pelagic but sinks rapidly when not swimming and can cling tightly to substrata. He found that it occurred in great numbers near the bottom. Jacob's findings are probably applicable to *P. cokeri* also.

REMARKS.—*P. cokeri* resembles most closely *P. coronatus* Williams, a species that occurs in coastal waters of eastern North America, from Nova Scotia (Willey, 1923) to Florida and the Gulf of Mexico (Davis, 1950; Grice, 1956; Woodmansee, 1958). Grossly, the most obvious difference is the appearance of the paired egg sacs; in *P. cokeri* they are subequal; in *P. coronatus* the right sac is reduced to a pair of eggs. Females of the 2 species also can be distinguished by differences in the genital and second urosomal segments; in particular the distinctive dorsal hump and lobes on the second urosomal segment of *P. cokeri* are missing in *P. coronatus*. The males differ chiefly in the structural details of P5. To aid in comparison, P5 of *P. coronatus* is illustrated in figure 7*k*. Its chief differences from *P. cokeri* are: (1) the presence of a spiniforn process on the right B1; (2) the spines on the left B1 are longer and more numerous; (3) there is no bilobed appendage on the right Re1 and the distal spine is heavier.

Family Pontellidae

Head separated from PedSeg 1, often with lateral hooks. PedSegs 4 and 5 fused or separate. Rostrum forked, usually ending in 2 strong prongs, often with thickened base bearing a lens, rarely absent. Eyes usually prominent, often with 1 or 2 pairs of dorsal lenses and a ventral lens. Urosome often asymmetrical, 1–3-segmented in female, 5-segmented in male, male genital opening on left side. Female A1 16–24-segmented, last 2 segments always fused; right A1 of male prehensile, sometimes strongly modified. A2 with B2 and Ri1 fused, terminal segments of Re shortened. Md blade with 5–7 teeth. B1 of Mx1 large; B2, Re, and Ri relatively small. Distal setae of Mx2 long and robust, coarsely plumose. B1 of Mx2 large, with long setae; B2 and Ri relatively small; Re of P1–P4 3-segmented; Ri of P1 2–3, of P2–P4 2-segmented. Female P5 small; Re of 1–2 segments; Ri of 1 segment or absent. Male P5 uniramous, each member 3–4-segmented; right P5 with chela.

Genus *Calanopia* Dana

Head without lateral hooks or lenses. PedSegs 4 and 5 fused; posterior corners pointed. Female urosome 2-segmented; male

urosome segment 2 often asymmetrical. Female A1 17-segmented; male right A1 with 4 segments distal to geniculation. Ri of P1–P4 2-segmented. Female P5 uniramous, 3–4-segmented. Male P5 4-segmented, the 2 distal segments forming a chela.

Calanopia americana Dahl

FIGURES 5*f–j*

Calanopia americana Dahl, 1894, p. 12, pl. 1, figs. 23–26.—A. Scott, 1909, p. 181, pl. 48, figs. 11–15.—Esterly, 1911, pp. 222–223, pl. 2, figs. 12, 15; pl. 3, figs. 27, 32; pl. 4, fig. 39.—T. Scott, 1912, p. 537, pl. 13, figs. 1–6.—Farran, 1929, p. 274.—Jesperson, 1940, p. 67.—Wilson, 1942, p. 172, fig. 2.—Davis, 1950, pl. 91 (table).—King, 1950, p. 129 (table).—Carvalho, 1952, p. 149, pl. 1, figs. 37–39.—Wickstead, 1956, pp. 15–16.—Bowman, 1957, passim, fig. 3h.—Woodmansee, 1958, p. 256.—Grice, 1960, p. 220.—Breuer, 1962, p. 167.—Fish, 1962, pp. 17–18.—Björnberg, 1963, pp. 58–59, fig. 30.—Reeve, 1964, passim.

FEMALE.—Length 1.4–1.6 mm. Prosome:urosome = 2.8. Pointed corners of PedSeg 5 relatively short. Genital segment slightly longer than posterior urosome segment. Distal segment of P5 ending in 3 spines; middle spine much longer than others.

MALE.—Length 1.4 mm. Urosome segment 2 without processes. Right A1, segment proximal to geniculation with strong process at proximal end of anterior margin perpendicular to segment. P5 as in figure 5*j*.

DISTRIBUTION.—Warmer parts of the western Atlantic. The most northern record is Jesperson's rather surprising one south of Iceland (62°40′ N., 19°05′ W.). As Jesperson suggested, the 3 specimens were very probably carried there by the Gulf Stream. South of Cape Hatteras *C. americana* is found regularly along the coast and offshore (unpublished observations). It occurs in the Gulf of Mexico, the Caribbean, and south to the southern coast of Brazil (Björnberg, 1963). Smithsonian-Bredin Expeditions have collected it at English Harbor, Antigua; Marigot Bay, Saint Lucia; and off Crown Point, Tobago. A net tow made in Lameshur Bay, Saint John, Virgin Islands, by Dr. John Randall at our request obtained numerous specimens of *C. americana*.

In the Puerto Rico collections, *C. americana* was obtained only from net tows made at night in Bahía Fosforescente. The collections from Tobago, Saint Lucia, Antigua, and Saint John were also made at night. Clarke (1934), working in Bermuda, found that during the day *C. americana* lives very close to the bottom and probably buries itself in the mud. At night it moves up close to the surface. The robust outer spines on Re of P1–P4 may assist *Calanopia* in clinging to the bottom during the day.

Family Acartiidae

Body narrow; head and PedSeg 1 separated; PedSegs 4 and 5 fused. Rostrum absent or consisting of 2 delicate filaments. Urosome 3-segmented in female, 5-segmented in male. Upper lip large, prominent, trilobed. A1 long and slender; segments poorly defined and reduced in number; setae generally plumose, some very long and arising from swellings of the segments. Right A1 of male prehensile, but not greatly modified. Ri of A2 slender, much longer than Re. Mxp much reduced, smaller than Mx2. P1–P4 slender; Ri 2-segmented, Re 3-segmented, outer spines reduced; inner setae long. Female P5 very small, uniramous, 2–3-segmented. Male P5 uniramous, prehensile; left P5 3-segmented; right P5 4-segmented.

Genus *Acartia* Dana

Prosome slender, usually widest posterior to middle, 2.5–4 times as long as urosome. Genital segment not laterally expanded. Male urosome segment 4 very small, sometimes partly fused with segment 5. Female A1 of 17–18 rather poorly defined segments. Mouthparts of male and female alike. B2 of A2 fused with Ri1, forming long slender segment armed with 9 setae. Gnathal lobe of Md with large gap between 2 anterior teeth; Re of palp much shorter than Ri. Mx1 with Ri apparently absent. Mx2 with long sparsely setose curved setae reaching forward to mouth. Mxp with B1 apparently absent; B2 broad; Ri much reduced. Female P5 3-segmented, segment 3 modified into long spine. Right male P5 larger than left, segment 3 with large inner lobe, segment 4 in form of curved clasper.

Remarks.—Steuer (1915, 1923) divided *Acartia* into 2 groups, "Acartiae arostratae" and "Acartiae rostratae," according to whether or not rostral filaments are present. He further divided the genus into 8 subgenera, of which 2 were arostrate and 6 rostrate. Gurney (1931) removed 1 arostrate subgenus (*Acartiella*) to the family Tortanidae and raised the rostrate subgenus *Paracartia* to its former full generic rank, leaving 6 subgenera of *Acartia*.

We believe that a thorough study of the genus *Acartia* must be carried out before the correctness of Steuer's action can be assessed, and we therefore reserve judgment.

Acartia lilljeborgii Giesbrecht

Figures 10*a–e*, 11*a*

Acartia lillgeborgii Giesbrecht, 1889, p. 25.
Acartia lilljeborgii Giesbrecht.—Giesbrecht, 1892, pp. 508, 518–521, 523, pl. 30, figs. 8, 20, 30; pl. 43, figs. 1, 19.—Dahl, 1894, p. 23.—Breuer, 1962, p. 167.
Acartia (*Odontacartia*) *lilljeborgi* Giesbrecht.—Steuer, 1915, p. 397; 1923, pp. 114–115, figs. 122–125.

Acartia lilljeborghii Giesbrecht.—Carvalho, 1952, pp. 150–151, pl. 1, figs. 40–41.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Björnberg, 1963, pp. 61–62, fig. 32.

Acartia Fariae Oliveira, 1945, p. 459, pl. 6, figs. 1, 2, 8.

Lahmeyeria turrisphari Oliveira, 1947, pp. 463–465, pl. 4, figs. 1–8.

FEMALE.—Length 1.15–1.20 mm. Rostral filaments present. PedSeg 5 produced into long spiniform process, dorsal to which are 2–3 minute spines. Urosome short; posterior margins of genital segment and urosome segment 2 armed with spinules; anal segment and caudal rami each with lateral groups of hairs. Caudal rami twice as long as wide. A1 about as long as body; proximal segments with margins produced into strong spines as in figure 10*d*. Segment 2 of P5 longer than broad, with median shelf distal to middle; segment 3 naked, slender, 3 times as long as segment 2, subequal to seta of segment 2.

MALE.—Length 1.02–1.04 mm. PedSeg 5 with shorter spiniform process than in female, single large dorsal spine about half as long as process, and minute spinule above dorsal spine. Posterior margins of urosome segments 2, 3, and 4 armed with spinules; segment 1 with group of hairs on each lateral surface; segment 2 with groups of fine spinules on lateral surfaces, extending onto ventral surface; segment 5 and proximal part of caudal ramus with lateral clumps of hairs. Caudal ramus about as wide as long. A1 without spiniform processes. P5 as in figure 11*f*.

DISTRIBUTION.—On the Pacific coast of South America it is known from the widely separated type localities, Valparaiso, Chile, and Guayaquil, Ecuador. On the Atlantic coast it has been collected along the coast of southern Brazil and the Gulf of Cariaco, Venezuela. Smithsonian-Bredin Expeditions have taken it at Marigot Bay and Castries Harbor, Saint Lucia, and Progresso, Yucatan, Mexico. The U.S. National Museum has specimens from Cardenas Bay, Cuba. In Puerto Rico it occurred both in the bays and over the shelf.

The armature of A1 and the pointed PedSeg 5 of *Acartia fariai* show clearly that Oliveira's (1945) species is synonymous with *A. lilljeborgii*. *Lahmeyeria turrisphari* Oliveira (1947) is an immature *A. lilljeborgii* in which the hooks on A1 are not fully developed. The illustrations of P2-P5 depict immature appendages.

Acartia spinata Esterly

FIGURES 10*f–i*, 11*b*, 12*a*

Acartia spinata Esterly, 1911, p. 224, pl. 1, figs. 3, 5; pl. 2, figs. 16, 19; pl. 3, fig. 24; pl. 4, figs. 37, 45.—Clarke, 1934, passim.—Moore, 1949, pp. 61–62.—Davis, 1950, pp. 90–91.—Woodmansee, 1958, p. 255.—Grice, 1960a, p. 224; 1962b.—Owre, 1962, p. 493 (list).—Reeve, 1964, passim.

Acartia (Acanthacartia) spinata Esterly.—Steuer, 1915, p. 396; 1923, pp. 25–26, figs. 115–121.

Female.—Length 1.16–1.24 mm. Rostral filaments present. PedSeg 5 rounded, posterior margin armed with dorsal series of 3–5 spinules and ventral series of 3–6 spinules. Posterior margins of genital and second urosome segments with dorsal rows of spinules. Caudal rami about 1.6 times as long as wide, dorsal surface covered with fine hairs. A1 about as long as body; segment 1 with spine on ventral surface; segment 2 with spine at proximal end of anterior margin and row of 3–5 smaller spines on posterior margin. Segment 2 of P5 more than twice as long as wide; segment 3 about 2.5 times as long as segment 2, bent inward distal to middle, about half as long as seta of segment 2.

Male.—Length 0.97–1.11 mm. Posterior margins of urosome segments 2–4 with dorsal rows of spinules; segment 2 with a few groups of lateral spinules; segment 4 with lateral bunch of hairs; caudal ramus slightly wider than long. A1 without spines. P5 as in figure 12*a*.

Distribution.—Bermuda (Esterly, Clarke, Moore); between Long Island and Bermuda (Grice); vicinity of Biscayne Bay, Fla. (Davis, Woodmansee, Reeve); Knight's Key, Fla. (Grice). Smithsonian-Bredin Expeditions have collected it in Fort de France Harbor, Martinique; near Pigeon Point, Tobago; and off Cocoa Point, Barbuda. It is abundant in Lameshur Bay, Saint John, Virgin Islands. In the Puerto Rican collections it occurred both in the bays and over the shelf. In Bermuda and in Biscayne Bay, Fla., *A. spinata* appears to be more abundant in the open waters outside the bays than in the bays themselves (Clarke, 1934; Woodmansee, 1958); Owre (1962) reports it from the Florida Current 10 miles east of Miami.

Acartia tonsa Dana

Figures 11*c–f*

Acartia tonsa Dana, 1849, p. 26.—Giesbrecht, 1889, p. 25; 1892, pp. 508, 518–522, pl. 30, figs. 7, 24, 34; pl. 43, figs. 6, 10.—Cleve, 1900, p. 44; 1901, p. 4.—Foster, 1904, pp. 75–77.—Scott, 1914, p. 8.—Wilson, 1932b, pp. 160–162, figs. 109a–d.—Sutcliffe, 1948, p. 234.—Davis, 1950, p. 91 (table).—Davis and Williams, 1950, passim.—King, 1950, p. 129 (table).—Carvalho, 1952, p. 152.—Bousfield, 1955, p. 36 (table).—Breuer, 1957, p. 143; 1962, p. 167.—Simmons, 1957, p. 177.—Woodmansee, 1958, p. 251.—Grice, 1960a, p. 221.—Bowman, 1961, passim.—Darnell, 1961, p. 555.—Cronin, Daiber, and Hulbert, 1962, pp. 77, 80–81.—Grice and Hart, 1962a, p. 294; 1962b.—Cervigón, 1962, p. 185.—Jeffries, 1962, passim.—Cuzon du Rest, 1963, passim.—Reeve, 1964, passim.

Acartia (Acanthacartia) tonsa Dana.—Steuer, 1915, p. 396; 1923, pp. 23–24, figs. 106–109.

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Acartia gracilis Herrick, 1887, p. 7.—Foster, 1904, pp. 75–76.
Acartia giesbrechti Dahl, 1894, p. 13, figs. 15–18.—Björnberg, 1963, p. 66.
Acartia (Acanthacartia) giesbrechti Dahl.—Steuer, 1915, p. 396; 1923, p. 23, figs. 102–105.
Acartia tonsa var. *cryophylla* Björnberg, 1963, pp. 64–66, fig. 34.

Female.—Length 0.87–0.97 mm. Rostral filaments present. Prosome:urosome = about 3.6. Posterior margins of PedSeg 5 smooth or with dorsal series of minute spinules. Posterior margins of genital and second urosome segments smooth or with a few dorsal spinules. Caudal rami about 1.6 times as long as wide. A1 reaching slightly beyond posterior margin of genital segment, without hooks or spines. Segment 2 of P5 with blunt process at anterior distal angle; segment 3 about 1.5 times as long as segment 2 and subequal to seta on segment 2, with swollen base and conspicuous barbed section proximal to slender tapered tip.

Male.—Length 0.77–0.80 mm. Urosome segments 1 and 5 with lateral tufts of hair; dorsal posterior margins of segments 2–4 with delicate spinules. Caudal rami about as long as wide. P5 as in figure 11*f*.

Distribution.—*A. tonsa* originally was described from Port Jackson, just north of Sydney, Australia. Since then it has been found along both coasts of North and South America and, more recently, in European waters, where it has been considered by some investigators to be a recent immigrant. Its global distribution is summarized by Remy (1927), who first discovered it in Europe. More recent reports on its occurrence in Europe are summarized by Conover (1957) and Schwarz (1960). Its distribution on the east coast of North America north of Cape Hatteras is summarized by Bowman (1961), who overlooked the 2 northernmost records, those of Steuer (1923) from the Bay of Fundy, and of Bousfield (1955) from the Miramichi estuary, New Brunswick. The most southern record in the western Atlantic is that of T. Scott (1914) from the Falkland Islands.

A. tonsa has been reported from 3 localities in the Indian Ocean: Java Sea (Cleve, 1901), Maldives (Wolfenden, 1905), and just north of the delta of the Indus River, 25° N., 67° E. (Cleve, 1904). These records are unsupported by illustrations or discussion, and we consider them highly questionable. In fact, there is some doubt in our minds that the *Acartia tonsa* from Pacific South America described by Giesbrecht is the one Dana described from Australia since Dana's description was so lacking in detail and his species has not been found for a second time along the Australian coast.

In Bahía Fosforescente, *A. tonsa* was outnumbered only by *Oithona hebes*. In the shelf area it was much less abundant and ranked 12th among the copepods.

Family Tortanidae

With the characters of the only genus, *Tortanus.*

Genus *Tortanus* Giesbrecht

Head without lateral hooks. Eye large, without lenses. Rostrum absent. Horsehoe-shaped plated fringe with hairs anterior to upper lip. Head and PedSeg 1 separated. PedSeg 5 fused with or separate from PedSeg 4, pointed and sometimes asymmetrical in female, rounded in male. Urosome 2–3-segmented and usually asymmetrical in female, 5-segmented in male. Caudal rami usually very asymmetrical in female, less so in male. A1 17-segmented, male right A1 prehensile, thickened in middle. Ri of A2 a little longer than Re. B2 of Md palp long; outermost tooth of gnathal lobe large and well separated from other teeth. Mx1 reduced to basal segment bearing short broad proximal lobe and long narrow distal lobe, the latter with 2 long and 1 shorter apical setae. Mx2 with much reduced proximal lobes. Mxp with well-developed basal segment armed with strong setae; endopod much reduced. Re of P1–P4 3-segmented; Ri of P1 2- or 3-segmented, of P2–P4 2-segmented. P5 uniramous in both sexes; 2–3-segmented and sometimes asymmetrical in female; right P5 of male forming a chela.

Tortanus compernis, new species

FIGURES 11*g*, 12*b–i*, 13*a–j*

Very similar to *T. setacaudatus* Williams but differing as follows:

FEMALE.—Length 1.14–1.19 mm. Prosome more slender, length: width = about 2.7 (about 2.3 in *T. setacaudatus*). Urosome more slender; anal spine smaller. Caudal rami not so straight; lateral margins concave; bent inward and in contact or nearly so near base; more slender, length:width = 5.4 (left ramus) and 4.6 (right ramus) (3.6 in both rami in *T. setacaudatus*). Distal segment of P5 with inner tooth widely separated from 2 outer teeth; inner margin with 3 setae near distal end.

MALE.—Length 1.02–1.08 mm. Length : width of prosome = 2.8–3.0 (2.4 in *T. setacaudatus*). Urosome segment 2 with lobe on posterior part of right margin larger, of different shape (cf. figs. 12*h*, 12*l*), bearing 2 short hairs on posterior margin. Caudal rami as in female, bent inward near proximal end; right ramus slightly longer than left. A1 as in *T. setacaudatus*, but segments slightly narrower. Segment 2 of P5 armed at tip with curved process, long heavy seta, and slender seta arising at base of heavy seta and crossing base of curved process.

Types.—Female holotype, USNM 109553, and 12 paratypes (2 males, 3 females, 7 juveniles), USNM 109554, from Bahía Fosforescente, Puerto Rico, Feb. 4, 1957.

Distribution.—This species is rather uncommon in the bays. *T. compernis* is the 3rd species of *Tortanus* to be reported from the western North Atlantic and the 1st from the West Indies. *T. discaudatus* (Thompson and Scott) is a northern species whose southern record is at the mouth of Delaware Bay (Deevey, 1960). *T. setacaudatus* Williams ranges south from Woods Hole (Wilson, 1932b), around Florida, and into coastal waters of the Gulf of Mexico. Grice (1960a) reports it from the west coast of Florida, and there are specimens in the U.S. National Museum from Biscayne Bay, Fla., and the Laguna Madre of Texas. Foster's (1904) *Tortanus* sp. from Louisiana is probably *T. setacaudatus*, as is the inadequately described *Calanus americanus* Herrick (1887) from Mobile Bay, Ala.

Remarks.—The specific epithet *compernis* (from the Latin "compernis," meaning "knock-kneed") refers to the characteristic shape of the caudal rami.

Order Harpacticoida

Family Longipediidae

Body elongate. Head fused with PedSeg 1; rostrum large, linguiform. Epimera of PedSegs 2–4 well developed; posterior corners angularly produced. Urosome narrowing posteriorly. Genital segment of female with transverse dorsal groove ending laterally in spine on either side. Anal operculum with terminal central spine and usually smaller ones on either side. Caudal rami short. A1 5-segmented. Re of A2 6-segmented. Ri of Md 2-segmented, Re 1-segmented. Re and Ri of P1–P4 3-segmented. Re3 of P2 very long. Distal segment of P5 more or less elongate, with 5 setae in female, 6–8 in male. Nauplius with long median caudal spine. Contains one genus, *Longipedia*.

Longipedia Claus, 1863

Although *Longipedia* is not a holoplanktonic genus, it appears to leave the bottom and swim freely more frequently than most other harpacticoids. Since we have collected it occasionally with plankton nets towed in Bahía Fosforescente, we are including it in this paper.

L. coronata Claus (1863), the type species by monotypy, cannot be assigned with confidence to any of the species currently recognized, and it has become customary to give the name *L. coronata* to the species fully described under this name by Sars (1903). Eventually a neotype of *L. coronata* Claus sensu Sars should be selected to legalize this practice and prevent confusion.

***Longipedia helgolandica* Klie**

Figures 15, 16*a–c*

Longipedia minor helgolandica Klie, 1949, pp. 97–100, figs. 1–3.—Noodt, 1956, p. 44; 1957, pp. 153, 224.

Longipedia coronata Claus.—Williams, 1906, p. 651; 1907, p. 72.—Fish, 1925, pp. 145, 146 (lists).—Wilson, 1932b, pp. 170–171, fig. 16.—[?] Nicholls, 1941, p. 384, fig. 1.—King, 1950, p. 129 (table).—[?] Pesta, 1959, p. 98, figs. 1–3.

Diagnosis.—A small *Longipedia,* about 0.8–0.9 mm. long. Margins of urosome segments smooth dorsally, minutely serrate ventrally. Anal operculum with long central spine and 2 pairs of lateral spines, outer pair much smaller than inner. Caudal setae unarmed. Re3 of P1 with 2 inner setae. Outer spine of Re3 of P2 inserted distad to proximal inner spine, present in both sexes. Female P5 as in figure 16*b;* male P5–P6 as in figure 16*c*.

Female.—Length, excluding rostrum and caudal setae, 0.78–0.93 mm. Prosome about 3 times as long as wide, about 1.2 times as long as urosome. Ventral margin of head with numerous fine setae as in *L. coronata.* Posterior margins of urosome segments smooth on dorsal and lateral parts; ventral margins of segments 2, 3, and 4 finely serrate. Anal operculum similar to that of *L. coronata;* central spine longer than rest of segment, reaching beyond caudal rami; 2 pairs of lateral spines, inner one well developed, curving mediad, with small medial to its base, outer one very small. Caudal rami about 1.4 times as long as wide at base, without surface spinules. Caudal setae as in *L. coronata:* 2 dorsal, 2 ventral, 3 terminal. Outer 2 terminal setae jointed near base; inner seta not jointed, shorter and more slender than other terminal seta. Longest seta about 0.85 as long as body. All caudal setae naked.

A1 as in *L. coronata.* A2, terminal segment of Re with 3 sparsely plumose setae as in *L. coronata* plus a short naked seta; second segment of Ri with 5 setae. Gnathal lobe of Md with 2 blunt teeth, followed by 2 teeth jointed at their bases, a rounded tooth, a pointed tooth, and a longer blade. Md palp as in *L. coronata* except that distal endopod segment has 5 rather than 6 apical setae. Mx1, Mx2, and Mxp as in *L. coronata.*

P1, Re3 with 2 inner setae. P2 as in *L. coronata,* Ri3 more than twice as long as Ri1 and Ri2 combined; long outer seta situated slightly distal to proximal inner spine; middle terminal seta deeply serrate on medial border. P3 and P4 like those of *L. coronata.*

P5 closely resembling figures of *L. coronata* P5 by Scott (1909, pl. 59, fig. 7), Gurney (1927, fig. 122B), and Nicholls (1941, fig. 1). Re about 2.5 times as long as greatest width, with 5 marginal setae

and an acute distal tooth. Relative lengths of the setae, numbered proximal to distal: 5>3>2=4>1.

MALE.—Urosome segments 3, 4, and 5 finely serrate on ventral margins, smooth on dorsal and lateral margins. A1 with setal armature shown in figure 15*d*. Terminal segment claw-shaped, bearing 2 setae and 2 aesthetascs. Penultimate segment subrectangular, bearing long plump aesthetasc. Antepenultimate segment with aesthetasc about as long but thinner than that on penultimate segment. P1 as in female. P2 without reduction in number of setae on Ri3; apex of Ri produced into short spiniform process posterior to the 3 large terminal setae. Ri2 of P4 in addition to large distal seta with very fine seta inserted on posterior surface near inner margin at about middle of margin.

P5 much smaller than in female. Re about 1.25 times as long as wide, bearing 6 setae of relative lengths shown in figure 16*c*. P6 consisting of broad flap bearing outer long slender seta, middle heavier seta, and inner short spiniform seta.

DISTRIBUTION.—Vicinity of Helgoland (Klie); Bad St. Peter, on west coast of Schleswig-Holstein, West Germany (Noodt); ?Gulf of Naples, Italy (Pesta); Woods Hole, Mass. (Fish); Marthas Vineyard, Mass. (Wilson); Narragansett Bay, R.I. (Williams); off Fort Myers, Fla. (King); Big Pine Key, Fla. (Yeatman, in litt.); Bahía Fosforescente, Puerto Rico (this paper); St. Johns, Antigua (this paper); Marigot Bay, St. Lucia (this paper); Progresso, Yucatán, Mexico (this paper).

REMARKS.—The Puerto Rican specimens agree in all particulars with Klie's description, except that Klie found Re of A2 to be 7-segmented while in our specimens it is 6-segmented. We believe that Klie's subspecies should be given specific rank. *L. minor* and *L. helgolandica* are probably to some extent sympatric, as Klie (1949, p. 100) indicates, and evidence of intergradation is nonexistent. We consider that the differences between *L. minor* and *L. helgolandica* are of about the same magnitude as the differences between other species of *Longipedia*.

All published North American records of *Longipedia* appear to be referable to *L. helgolandica*. Wilson's (1932) specimens of *L. coronata* from Katama Bay, Marthas Vineyard, Mass., which are deposited in the U.S. National Museum, closely resemble the Puerto Rican specimens. We have also identified specimens from Marigot Bay, Saint Lucia, taken in a plankton tow during the 1959 Smithsonian-Bredin Expedition to the West Indies. Dr. Harry C. Yeatman (in litt.) has collected specimens of a *Longipedia* from Big Pine Key, Fla., which he believes to be conspecific with the Puerto Rican species.

The records of *L. coronata* by Williams (1906, 1907) from Rhode Island, by Fish (1925) from Woods Hole, Mass., and by King (1950) from off Fort Myers, Fla., probably are all misidentifications: these authors almost undoubtedly had specimens of *L. helgolandica.*

Two records of *Longipedia* from South America are known to us. Carvalho's (1952) *L. coronata* from the Bay of Santos, Brazil, cannot be identified with certainty since Carvalho's drawings do not show sufficient detail and his description does not include characters useful in distinguishing the species of *Longipedia.* His figure 45 shows the 4 outer setae of Re of P5 to be subequal as in *L. coronata,* but Re is considerably shorter in relation to its width than in *L. coronata.* A reexamination of Carvalho's specimens is needed.

Jakobi (1954) described *L. mourei* from the Bay of Paranaguá, Brazil. It agrees with *L. helgolandica* in the dorsal margins of the urosome segments being smooth and in having 2 inner setae on Re3 of P1. It differs from all other species of *Longipedia* in that the female P5 has only 4 setae in addition to the terminal spine.

Nicholls' (1941) *Longipedia coronata* may be conspecific with *L. helgolandica.* The presence of 2 inner setae on Re3 of P1 and the structure of P5 exclude it from *L. coronata.* The outer pair of lateral spines on the anal operculum are relatively larger than in *L. helgolandica* and more like those of *L. coronata.* Nicholls' specimens were about 1 mm. in length, slightly larger than our specimens of *L. helgolandica* but smaller than *L. coronata.*

Pesta's (1959) specimen of *L. coronata* from the Gulf of Naples may be *L. helgolandica.* The small size (0.71 mm.) and the relative lengths of the setae on Re of P5 agree with *L. helgolandica* rather than with *L. coronata.* Pesta seems to have based his identification on the presence of 5 rather than 6 setae on Re3 of P1; however, it is possible that Pesta confused the exopod and endopod of this leg, for his figure 2, labelled "Engl. Exp. P1 ♀," is actually an illustration of the endopod. Ri3 of P1 has 5 setae in all species of *Longipedia.* P5 in Pesta's specimen is shaped more like that of *L. helgolandica* than the narrower P5 of *L. minor.*

Family Tachidiidae

Body elongated. Urosome nearly as broad as or much narrower than prosome. A1 4–9-segmented, usually with plumose setae. Re of A2 1–3-segmented. Re and Ri of Mx1 usually reduced. Re of P1 2–3-segmented, with 1 inner seta on middle segment and 5–6 appendages on distal segment. Ri of P1 not prehensile, 2–3-segmented, with inner setae on all segments. Ri of P2 2–3-segmented; Ri of P4 3-segmented. Armature of P1–P4 rather variable. Ri2 of male P2 often produced into pointed process; one seta of distal seg-

ment rarely modified weakly. Re of P2 and P3 sometimes more strongly developed in male than in female. Rami of P5 either separate or fused; male P5 sometimes a single plate (from Lang, 1948, p. 281).

Genus *Euterpina* Norman

Rostrum produced into strong point. Caudal ramus somewhat longer than wide. A1 of female 7-segmented, without plumose setae; in male prehensile, with plumose setae. Re of A2 1-segmented. B of Md without setae. Mx1 with rudimentary Re and Ri. Mx2 with small 2-segmented Ri. Mxp very slender, with long terminal claw. P1 with short 2-segmented rami and weak sexual dimorphism; Re1 with inner seta; Re2 with 7, Ri2 with 6 appendages. P2–P4 with 3-segmented rami; Ri shorter and more slender than Re; Re1 and Re2 with outer spines. B of P1–P4 without outer setae. Ri of male P2 sometimes (always?) 2-segmented. Female P5 a long, nearly square-cornered plate with 4 terminal spines, 1 outer spine, and proximal outer seta. Male P5 fused at base, divided at tip by median groove reaching halfway to base, armed with 2 terminal spines on either side, 1 outer spine with seta arising at its base, and proximal outer seta (from Lang, 1948, p. 285).

Euterpina acutifrons (Dana)

Figures 14*d–l*

Harpacticus acutifrons Dana, 1847, p. 153.

Euterpe acutifrons (Dana).—Dahl, 1894, p. 13.—Cleve, 1900, pp. 65–66.—Davis, 1950, p. 97 (table).

Euterpina acutifrons (Dana).—Carvalho, 1945, pp. 103–104, pl. 5, fig. 22; 1952, pp. 163–164, pl. 2, figs. 85–88.—Lang, 1948, pp. 285–287, fig. 142, map 343 [synonomy, distribution].—King, 1950, p. 130 (table).—Grice, 1956, pp. 56–57.—Woodmansee, 1958, p. 256.—Deevey, 1960, p. 33.—Légaré, 1961, p. 206.—Zoppi, 1961, table 4.—Björnberg, 1963, pp. 71–72, fig. 37.

With the characters of the genus, which is monotypic. Length of Puerto Rico specimens: female, 0.53–0.60 mm.; male, 0.46 mm.

Distribution.—Worldwide in tropical and subtropical coastal waters (see Lang, 1948, map 343, p. 1588). Although never abundant in the Puerto Rico samples, *E. acutifrons* occurred regularly in the bays and over the shelf and was the most common planktonic harpacticoid.

Family Ectinosomidae

Body slender, usually without noticeable boundary between prosome and urosome. Eye absent. PedSeg 1 fused with head. Female genital segment without transverse suture. A1 short, not more than 7-segmented in female. Re of A2 at most 3-segmented;

terminal segment with setae only at apex. Md usually well developed. Mx2 with large basal segment bearing at most 3 endites. Mxp very characteristic; 3-segmented; middle segment usually long. Re of P1 3-segmented, without inner seta on Re1; Ri sometimes prehensile and 2-segmented, usually nonprehensile and 3-segmented. P2–P4 usually with 3-segmented rami; Ri sometimes 2-segmented. P5 similar in male and female, 2-segmented; medial lobe of segment 1 with 2 apical setae. 1 egg sac.

Genus *Microsetella* Brady and Robertson

Body fusiform, compressed laterally. Rostrum short, immobile, bent ventrad, and not visible from above. Caudal rami short, the 2 middle terminal setae very long. Female A1 6-segmented; segment 3 elongate. Re of A2 3-segmented. Md well developed; gnathal lobe with few teeth; Re very small; Ri large, with single enlarged seta on middle of inner margin. Re and Ri of P1–P4 3-segmented; Ri longer than Re. P5 of female foliaceous; distal segment with 3 marginal and 1 surface setae. 2 species.

Microsetella norvegica (Boeck)

FIGURES 16*d–e*

Setella norvegica Boeck, 1865, p. 281.
Microsetella norvegica (Boeck).—Wilson, 1932a, p. 38; 1932b, pp. 176–177, fig. 21.—Lang, 1948, pp. 230–232, fig. 122–1 [synonomy, literature, distribution].—Carvalho, 1952, p. 155, pl. 2, figs. 47–50.—Deevey, 1952b, p. 146; 1956, p. 139.—Fish, 1955, pp. 242–249 [life history].
Microsetella atlantica Brady and Robertson.—Cleve, 1900, pp. 69–70.

FEMALE.—Longest caudal seta about as long as body; next longest about as long as urosome. Medial seta on inner lobe of segment 1 of P5 about half as long as outer seta. Length 0.35–0.53 mm.

MALE.—Smaller than female; length 0.33–0.42 mm. P5 much reduced.

DISTRIBUTION.—A eurythemic and euryhaline species, widely distributed in all oceans. In the Puerto Rican collections it was taken on the shelf but not in the bays.

Order Cyclopoida

Family Corycaeidae

Prosome cylindrical or conical, 2–4-segmented. Head with pair of prominent ocular lenses located close together, sometimes contiguous. Posterior corners of PedSeg 3 and usually PedSeg 4 produced into points. PegSeg 5 very short. Urosome 2–3-segmented. Caudal rami usually narrow and long, with 3 terminal and 1 lateral setae. A1

6-segmented, with nonplumose setae and without aesthetascs, not geniculate in male. A2 prehensile, with long spines on B1 and B2; terminal spine longer in male than in female. Mx2 2-segmented, ending in strong hook. Mxp 3-segmented. Re of P1–P4 3-segmented; Ri of P1–P3 3-segmented; Ri of P4 1-segmented or absent. P5 represented by 2 unequal setae.

Genus *Corycaeus* Dana

Setae of B1 and B2 of female A2 nonplumose; seta of B2 of male A2 finely plumose on 1 margin. Urosome 3-segmented (2-segmented in subgenus *Agetus*). Ventral process rounded. Re of P1–P3 with 1–1–3 outer spines. P4 with rudimentary Ri consisting of small knob bearing 1 or 2 setae; Re with 0–1–1 outer spines.

Subgenus *Ditrichocorycaeus* M. Dahl

Small species characteristic of coastal plankton. Seta of B1 of A2 3 times longer than seta of B2 in female, only slightly longer in male.

Corycaeus (*Ditrichocorycaeus*) *amazonicus* F. Dahl

FIGURES 17*a–e*

Corycaeus amazonicus F. Dahl, 1894b, p. 71.—M. Dahl, 1912, pp. 69–71, pl. 10, figs. 1–10.—Farran, 1929, p. 296.—M. S. Wilson, 1949, p. 325.—Grice, 1956, pp. 54–55; 1960, p. 221.—Deevey, 1960, pp. 33–34.—Björnberg, 1963, p. 83, fig. 44.

FEMALE.—Length 1.12 mm. Genital segment inflated dorsally. Genital and anal segments subequal; caudal rami slightly longer than genital segment. Re3 of P1 incised at apex so that terminal spine is set at an angle. Re2 and Re3 of P4 subequal; outer seta of Re1 extends beyond distal margin of Re2.

MALE.—Length 0.88 mm. Anal segment about ⅔ as long as genital segment; caudal rami slightly longer than anal segment.

DISTRIBUTION.—East coast of the United States from Block Island Sound, R.I. (Deevey), to Port Aransas, Tex. (M. S. Wilson); Bermuda, Tortugas (M. Dahl); mouth of Amazon River, Brazil (F. Dahl); Rio de Janeiro, Brazil (Farran). In the Puerto Rican collections it appeared in small numbers in the bays and over the shelf.

Corycaeus (*Ditrichocorycaeus*) *subulatus* Herrick

FIGURES 17*f–h*, 18*a–c*

Corycaeus subulatus Herrick, 1887, pp. 48–49, pl. 1, figs. 7A–B.

Corycaeus lubbocki Giesbrecht.—C. B. Wilson, 1932a, p. 42.

Corycaeus (*Ditrichocorycaeus*) *americanus* M. S. Wilson, 1949, pp. 321–326, pl. 18, figs. 1–14.—King, 1950, p. 131 (table).—Grice, 1956, pp. 55–56; 1960, pp. 221–222.—Deevey, 1960, pp. 33–34.—Cronin, Daiber, and Hulbert, 1962, p. 72 (table).

FEMALE.—Length 1.1–1.2 mm. Genital segment inflated dorsally, about twice as long as anal segment. Caudal rami divergent, longer than urosome. Re3 of P1 as in *C. amazonicus*. Proportional lengths of Re1–Re3 of P4 approximately 27:15:20; outer seta of Re1 long as in *C. amazonicus*.

MALE.—Length 0.85–1.0 mm. Genital segment about twice as long as anal segment. Caudal rami about ¾ as long as urosome.

DISTRIBUTION.—Atlantic coast of the United States, from Block Island Sound, R. I. (Deevey), to Port Aransas, Tex. (M. S. Wilson). In the Puerto Rican collections it occurred in small numbers in the bays and on the shelf.

REMARKS.—Although Herrick's description and illustrations differ in some respects from those of M. S. Wilson, we believe the discrepancies can be attributed to Herrick's inaccuracies. We place *C. americanus* in synonomy with *C. subulatus* for the following reasons:

1. Herrick's statement "The inner ramus of the fourth feet is reduced to a process bearing two long setae" places his species in the subgenus *Ditrichocorycaeus*.

2. The length of the caudal rami shown in Herrick's figure 7 eliminates all known species of *Ditrichocorycaeus* except *americanus*.

3. Other species of *Corycaeus* with long caudal rami (e.g., *Urocorycaeus* spp.) are not inhabitants of coastal water.

4. Mobile Bay, Ala., the type locality for *C. subulatus*, is within the range of *C. americanus*.

Genus *Farranula* C. B. Wilson

Prosome 2-segmented. PedSeg 4 fused with PedSeg 3; posterior corners not produced into points. Ventral process beak shaped in female, rounded in male. Urosome 2-segmented. Setae of B1 and B2 of A2 plumose in both sexes. Re of P1–P4 with 0–0–1 outer spines. Ri of P4 absent.

Farranula gracilis (Dana)

FIGURES 18*d–g*

Corycaeus gracilis Dana, 1849, p. 35.—F. Dahl, 1894, p. 69.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.

Corycaeus (*Corycella*) *gracilis* Dana.—M. Dahl, 1912, pp. 108–111, pl. 14, figs. 11–21; pl. 15, figs. 15, 16, 29, 30.

Corycella gracilis (Dana).—Björnberg, 1963, pp. 85–86, fig. 47.

Corycaeus carinatus Giesbrecht.—Wheeler, 1901, p. 192, fig. 30.

Corycella carinata (Giesbrecht).—Wilson, 1932a, p. 41; 1932b, p. 362, fig. 220.

FEMALE.—Length 0.94 mm. Urosome in lateral view as in figure 18*g* with part of dorsal margin subparallel to ventral margin.

MALE.—Smaller than female, and with longer caudal rami.

REMARKS.—This species has been misidentified by Wheeler, Wilson, and probably other authors. Wheeler's illustrations, reprinted in Wilson (1932b), agree closely with M. Dahl's figures of *F. gracilis*, said by Dahl to be an Atlantic species. *F. carinata* has a rather different urosome shape (see Dahl, 1912, pl. 15, fig. 22) and is considered by Dahl to be a Pacific species.

The urosome of *F. concinna* (Dana) is similar in shape to that of *F. gracilis* but is lower and longer. Although M. Dahl states that it is a Pacific species, Moore (1949), Björnberg (1963), and Owre (1962) have reported it from the Atlantic.

Family Oithonidae

Prosome and urosome quite distinct; prosome moderately wide; urosome narrow. Female A1 rather long, armed with long setae, without aesthetascs; both male A1 geniculate, terminal segment with aesthetasc. A2 2–4-segmented; Re absent. Mouthparts biting. Re and Ri of P1–P4 2- or 3-segmented. P5 a small conical segment (sometimes lacking) with 1–2 apical setae; another seta on side of segment anterior to P5.

Genus *Oithona* Baird

Head rounded or produced into beak-shaped rostrum. A2 2–3-segmented. Md with small 1-segmented Ri and 4-segmented Re; B2 with 2 setae on medial margin. Re and Ri of Mx1 1-segmented. Re and Ri of P1–P4 3-segmented except Ri of P1, rarely 2-segmented.

Members of the genus *Oithona* are among the most numerous and characteristic plankters of inshore waters throughout the world. The genus is large and the characters used to separate some of the species are slight. Some species have been described inadequately; e.g., such important characters as P5 and the terminal setae of the Md have been omitted in some descriptions. Identification consequently is sometimes difficult, and we therefore give rather detailed diagnoses of the Puerto Rican species and the artificial key below.

Kiefer (1935) removed the species of *Oithona* having 2 terminal setae on P5 and established the genus *Dioithona* for them. His decision, based on long experience with freshwater cyclopoids where the armature of the rudimentary P5 has high taxonomic value, has not been generally followed. We are not convinced that the genus should be divided on the basis of a single character; a thorough revision, using all available characters, is needed to determine the validity of Kiefer's action. Of the Puerto Rican species, only *Oithona oculata* is a *Dioithona*.

Key to Females of the Inshore Puerto Rican Species of *Oithona*

1. Re3 of P4 with 3 outer setae; anal segment short, about half as long as preceding segment; A1 reaches about to middle of Ped Seg 1; Ri of P1 2-segmented. . . . . **O. simplex** Farran
   Re3 of P4 with 2 outer setae; anal segment subequal to preceding segment; A1 reaches beyond Ped Seg 1; Ri of P1 3-segmented 2
2. Head with dorsal ocular lenses; genital segment with transverse dorsal ridge; P5 with 2 terminal setae. . . . . **O. oculata** Farran
   Head without dorsal lenses; genital segment without dorsal ridge; P5 with 1 terminal seta 3
   Head rather pointed; prosome about 1.5 times as long as urosome, with spots of blue pigment on ventral surface; B2 of Md with 2 heavy blunt terminal setae; egg sacs compact, with about 8 eggs in each.
   O. hebes Giesbrecht
3. Head truncate; prosome about 1.2 times as long as urosome, without ventral pigment; B2 of Md with long pointed terminal seta armed with coarse setules; egg sacs loose, with more than 20 eggs in each.
   O. nana Giesbrecht

Oithona hebes Giesbrecht

FIGURES 19, 20*a–b*

Oithona hebes Giesbrecht, 1891, p. 475; 1892, pp. 538, 549, pl. 34, figs. 8–9.—Grandori, 1912, p. 15.—Farran, 1913, p. 191 (key).—Rosendorn, 1917, p. 44.—Pesta, 1921, p. 551, fig. G5.—Kiefer, 1929, pp. 9–10; 1936, pp. 320–322, figs. 1–5.—Rose, 1933, p. 280, fig. 354.—Lindberg, 1950, p. 274 (key).

[?] *Oithona ovalis* Herbst, 1955, pp. 214–215, figs. 27, 28a–c.—Björnberg, 1963, pp. 76–77.

Oithona minuta T. Scott.—Coker and González, 1960.

[not] *Oithona hebes* Giesbrecht.—Wilson, 1942, p. 196.

FEMALE.—Length 0.53–0.56 mm. Prosome:urosome = about 1.5. Prosome oval, widest at posterior end of cephalosome. Head rather pointed anteriorly. Rostrum absent. Last 3 urosome segments subequal. Caudal ramus about 3 times as long as wide; lateral marginal seta inserted at proximal ⅓ of margin, 0.75 as long as lateral apical seta; relative lengths of apical setae (lateral apical seta = 1) 1:3.0:4.7:2.4; dorsal seta = 2.5. A1 reaches anterior margin of PedSeg 2. B2 of Md bears 2 heavy, equal setae, armed on margins with short setules; Ri bears 5 setae. Re of P1–P4 armed as follows:

Outer seta: 1–1–3, 1–1–3, 1–1–3, 1–1–2.

Inner setae: 0–1–4, 1–1–5, 1–1–5, 1–1–5.

Distal inner seta of Ri2 of P4 very robust. P5 with single long terminal seta.

MALE.—Length 0.48–0.54 mm. Prosome:urosome = about 1.4. Head wider than in female, truncate anteriorly. A1 usually folded in characteristic position as in figure 20*a*. A2, segment 3 relatively longer and narrower than in female. Setae on B2 of Md somewhat weaker than in female.

Color.—Distinctive pattern of blue pigment on ventral surface of prosome: ⊥-shaped patch in center of head between and behind ganglia; a spot at base of each A2 and a spot in midline between these (female) or a little more posterior (male); a much brighter and more conspicuous spot behind B1 of each P1.

This is the only species of *Oithona* in the Puerto Rican bays investigated that has pigment in the prosome; hence, identification is easy in freshly preserved collections.

Remarks.—*Oithona hebes* was described briefly by Giesbrecht in 1889 from 2 females collected at the mouth of the Guayaquil River, Ecuador. Grandori (1912) reported 3 females from Laguna Veneta, Italy, but his identification was not supported by any description or illustration and must be considered questionable. Although listed in generic revisions, the species was not discovered again until Kiefer (1936) received several females and 2 males from Maria Farinha, in northeast Brazil, and redescribed it. The Puerto Rican specimens fit closely the accounts of *O. hebes* given by Giesbrecht and by Kiefer except that the caudal rami are relatively longer. In the specimens from Ecuador and from Brazil the rami are only about twice as long as wide, while in the Puerto Rican specimens the rami are 3 times as long as wide. A number of specimens from Puerto Rico were sent to Dr. Kiefer at Konstanz; he kindly compared them with his Brazilian specimens and reported good agreement except in the length:width ratio of the caudal rami. Dr. Kiefer also pointed out a character that we had overlooked: the robust distal inner seta of Ri2 of P4.

In the genus *Oithona,* considerable significance is given to the relative lengths of the caudal setae. Unfortunately, Giesbrecht gives no information on these setae in his accounts of *O. hebes,* and the lateral apical setae were broken in Kiefer's specimens. After receiving Puerto Rican specimens from us, Dr. Kiefer reexamined his Brazilian material and confirmed his earlier report on the incompleteness of the caudal setae, but he also wrote: "Nachdem diesen Befunden muss ich aber annehmen, das die äusserste Endborste auch bei den brasilianischen Tieren mindestens halb so lang wie die innerste war" (in litt., March 2, 1963).

In his key to the species of *Oithona,* the late K. Lindberg (1950) separates *O. dissimilis* and *O. hebes* by the relative lengths of their medial and lateral apical caudal setae. Lindberg indicates that the medial apical seta is about 4 times as long as the lateral apical seta in *O. hebes* but not more than 2.5 times as long in *O. dissimilis.* (In his original description of *O. dissimilis* (1940), the ratio is 2.2–2.3). Thus, in Lindberg's key the Puerto Rican specimens run to *O. dissimilis;* however, in *O. dissimilis,* from brackish water on the east coast of India, the head is truncate rather than pointed anteriorly;

A1 is a little longer, reaching the middle of the posterior margin of PedSeg 4; and Re3 of P1 has only 2 instead of 3 outer spines. Lindberg gives no indication as to the source of his information on the caudal setae of *O. hebes*. Pesta (1921) and Rose (1933) repeated Giesbrecht's illustrations and diagnosis without adding any details; hence, Lindberg's information on the caudal setae of *O. hebes* was not taken from any literature known to us.

At our request, Dr. Peter Dohrn kindly searched for *Oithona hebes* in the Giesbrecht collection at the Naples Zoological Station and reported (in litt., May 4, 1963) that it is not present. Fortunately, through the kindness of Dr. Harold Loesch, Instituto Nacional de Pesca del Ecuador, we obtained several plankton samples from Guayaquil, Ecuador, the type locality of *O. hebes*. Some of these samples contained specimens of *O. hebes* agreeing closely with the descriptions of Giesbrecht and of Kiefer. As shown in figure 20*b*, the caudal ramus is twice as long as wide, and the medial apical seta is about twice as long as the lateral apical seta, contrary to the statement in Lindberg's key.

The identity of *Oithona hebes* is clarified by these findings, but there remains the problem of how to treat the Puerto Rican form, which differs only in the proportions of the caudal ramus. Should it be considered a distinct species, a subspecies of *O. hebes*, or included under *O. hebes* without further nominal status? We are arbitrarily following the last course here but wish to emphasize that a decision cannot be made until reasonably complete information is available on the distribution of the 2 forms and the presence or absence of intergrades.

O. ovalis Herbst, from Cananéia, Brazil, appears to be very close to, if not identical with, *O. hebes*. Other species that resemble *O. hebes* in having 2 thick setae on B2 of Md are *O. minuta* T. Scott (1894) and *O. brevicornis* Giesbrecht (1891). *O. minuta*, from the Gulf of Guinea, differs in that P5 has 2 terminal setae (placing it in *Dioithona* Kiefer, 1935); the genital segment has lateral spinulose areas, and the lateral apical setae of the caudal rami are very long. *O. brevicornis*, originally described from Hong Kong, differs in having a well-developed rostrum. A species of *Oithona* identified as *O. brevicornis* by Wilson (1932a, 1932b) and Grice (1960a, 1960b) occurs along the east and Gulf of Mexico coasts of the United States. Wilson reported it from Chesapeake Bay (1932a) and Penzance Pond, Woods Hole, Mass. (1932b), and Grice found it to be abundant in nearshore and estuarine waters along the west coast of Florida.

One of us (Bowman) has identified this species from off Jacksonville, Fla., and from Laguna Madre of Texas. The identity of the United States species with the Hong Kong species is questionable since in

the former the head is more rounded in dorsal view, the rostrum is not so strongly curved, and the lateral marginal seta of the caudal ramus is shorter than the ramus. Giesbrecht's descriptions of *O. brevicornis* are quite limited, and a detailed study of Hong Kong specimens is badly needed. In addition to the difference in rostral development, differences in the setae of B2 of the Md distinguish the American *O. brevicornis* from *O. hebes*. In the former the marginal setules are fewer and more widely spaced on the inner seta than on the outer seta, whereas in *O. hebes* the 2 setae are alike. In both species, Ri bears 5 setae although Rosendorn (1917) shows only 4 setae in *O. brevicornis*.

Oithona hebes was very abundant in the Puerto Rican bays. It was less numerous on the shelf but still ranked 4th among the copepods.

Oithona nana Giesbrecht

Figures 20*c–g*

Oithona nana Giesbrecht, 1892, pp. 541–546, 549, pl. 4, fig. 8; pl. 34, figs. 10, 11, 20, 24, 26, 34, 35, 42; pl. 44, figs. 2, 6.—Williams, 1907, p. 72.—Grandori, 1912, p. 14.—Gurney, 1927, pp. 159–160.—Carvalho, 1952, p. 167, pl. 2, figs. 95, 96.—Yamazi, 1956, p. 166, pl. 16, figs. 6A, B.—Grice, 1960a, p. 222; 1960b, pp. 487–488, figs. 7–11.—Tanaka, 1960, pp. 59–60, pl. 26, figs. 1–4.—Björnberg, 1963, p. 75, fig. 39.

Oithonina nana (Giesbrecht).—Sars, 1913, p. 5.—Wilson, 1932b, pp. 316–317, figs. 190c–d.—Davis, 1950, p. 90.—Davis and Williams, 1950, pp. 523–525 (tables).—King, 1950, p. 130 (table).—Woodmansee, 1958, pp. 254–255.

Female.—Length 0.60–0.66 mm. Prosome:urosome = about 1.2. Head truncate anteriorly. Rostrum absent. Anal segment slightly shorter than 2 preceding segments, about as long as caudal ramus. Caudal ramus about 2.3 times as long as wide; lateral marginal seta inserted slightly proximal to middle of margin, about 0.8 as long as ramus. Lateral apical seta short, about half as long as ramus. A1 reaches middle of pedigerous segment 3. B2 of Md with long terminal seta armed on margins with strong setules and a much shorter slender seta; Ri with 4 setae. Re of P1–P4 armed as follows:

Outer setae: 1–1–3, 1–1–3, 1–1–3, 1–1–2.
Inner setae: 1–1–4, 1–1–5, 1–1–5, 1–1–5.

P5 with single terminal seta.

Male.—Length 0.45–0.55 mm. Prosome:urosome = about 1.1. A1 typically folded as in *O. hebes*. P5 and P6 with single terminal setae.

Remarks.—*O. nana* can be identified by the long urosome and A1 and the characteristic terminal seta on B2 of Md. The egg sacs are characteristic, being oval, rather loose, and usually having more than 20 eggs in each. In the other bay species of *Oithona*, the sacs are compact and have fewer eggs.

DISTRIBUTION.—Widespread in temperate and tropical coastal waters. In the Puerto Rican collections it was common both in the bays and on the shelf.

Oithona oculata Farran

FIGURES 20*h*–*i*, 21*a*–*e*

Oithona oculata Farran, 1913, pp. 188–189, pl. 30, figs. 8, 9; pl. 31, figs. 2–9.—Rosendorn, 1917, pp. 37–39.—Kiefer, 1929, p. 10.—Sewell, 1947, pp. 254–255.—Tanaka, 1960, pp. 60–61, pl. 26, figs. 5–10.—Björnberg, 1963, p. 76.—Vervoort, 1964, pp. 25–26.

Dioithona oculata (Farran).—Kiefer, 1935, p. 322.

FEMALE.—Length 0.65–0.70 mm. Prosome:urosome = about 1.5. Head rounded anteriorly. Rostrum absent, but head is slightly produced in front of and between A1 (fig. 20*h*). Genital segment with sclerotized transverse dorsal ridge in middle. Last 3 urosome segments and caudal ramus subequal. Caudal ramus about 2.8 times as long as wide; lateral marginal seta inserted slightly proximal to middle of margin, half as long as lateral apical seta; relative lengths of apical seta (lateral apical = 1) 1:3.4:4.1:1.9; dorsal seta = 1.1. Head with pair of lenses surrounded by blue pigment. A1 reaches middle of PedSeg 2. B2 of Md with 2 slender plumose setae; Ri with 5 setae. Re of P1–P4 armed as follows:

Outer setae: 1–1–3, 1–1–3, 1–1–3, 1–1–2.
Inner setae: 1–1–4, 1–1–5, 1–1–5, 1–1–5.

Terminal seta of P4 slightly longer than Re. P5 consists of short broad basal segment with long outer seta and narrow distal segment bearing 2 apical setae reaching posterior margin of genital segment. Egg sacs each with 8 eggs.

MALE.—Length about 0.60 mm. Prosome:urosome = about 1.4. Terminal segment of A1 drawn out into point distal to insertion of setae and aesthetascs. Seta of P6 reaches beyond middle of urosome segment 3.

REMARKS.—The conspicuous ocular lenses, the transverse ridge on the genital segment, and the 2 terminal setae on P5 separate *O. oculata* from other Puerto Rican species of *Oithona*. The ridge on the genital segment is not mentioned by Farran and not shown in his illustrations. We have not seen material from the type locality (Christmas Island, Indian Ocean), but we have examined specimens from Ifaluk Atoll, Caroline Islands, also studied by Vervoort (1964) and identified by him as *Oithona oculata*. The Ifaluk specimens closely resemble the Puerto Rican specimens and have the dorsal transverse ridge on the genital segment. The only difference we have noted is that the caudal ramus is slightly shorter in relation to its width in the Ifaluk specimens (cf. figs. 21*c*, 21*d*).

Farran also shows shorter terminal setae on P5 in the Christmas Island specimens, perhaps because the distal parts of these setae are very delicate and difficult to see.

Oithona alia (Kiefer, 1935), from India, resembles *O. oculata* but differs in lacking ocular lenses and in having the inner terminal seta of P5 much shorter than the outer seta. Other differences given by Kiefer are of doubtful significance.

Distribution.—Christmas Island, Indian Ocean (Farran); Samoa (Rosendorn); Nicobar Island (Sewell); Cape of Good Hope (Tanaka); Ifaluk Atoll, Caroline Islands (Vervoort); coast of Brazil (Björnberg). Our Puerto Rican specimens constitute the 2nd Atlantic record for this species. We have also identified specimens from Lameshur Bay, St. John, Virgin Islands.

Oithona simplex Farran

Figures 21*f–i*

Oithona simplex Farran, 1913, pp. 187–188, pl. 29, figs. 10–14; pl. 30, figs. 1, 2.—Rosendorn, 1917, pp. 44–46.—Gurney, 1927, p. 160.—Kiefer, 1929, p. 9.—Grice, 1960a, pp. 222–223; 1960b, p. 488, figs. 12–18.—Tanaka, 1960, pp. 64–65, pl. 28, figs. 1–6.

Female.—Length 0.36–0.43 mm. Prosome:urosome = about 2.0. Prosome rather heavyset in dorsal view; head broadly rounded anteriorly; rostrum absent. Anal segment about twice as wide as long; caudal ramus rather short, about 1.5 times as long as wide, lateral marginal seta inserted near proximal end, nearly as long as ramus. Lateral apical seta about twice as long as ramus. Relative lengths of apical setae (lateral apical seta = 1): 1:2:3:1.3. A1 reaches to or slightly beyond posterior margin of PedSeg 1. B2 of Md bearing a long stiff seta armed with a few large setules and a slender finely plumose seta; Ri with 5 setae. Ri of P1 2-segmented. Re of P1–P4 armed as follows:

Outer setae: 1–1–3, 1–1–3, 1–1–3, 1–1–3.

Inner setae: 1–1–4, 1–1–5, 1–1–5, 1–1–5.

P5 with single terminal seta.

Male.—Length about that of female. Prosome:urosome = about 1.4. Anal segment very short, as in female. A1 typically folded in U-shape.

Remarks.—*O. simplex* can be distinguished from the other Puerto Rican species of *Oithona* by its small size, plump prosome, short urosome, short anal segment, the setae on B2 of the Md, and the 2-segmented Ri of P1. As Grice (1960b) has pointed out, it differs in several respects form Farran's description. The prosome:urosome ratio is greater; A1 is shorter; the small inner seta of Re1 and the

inner seta on Ri1 of P1 were missing in Farran's specimens; Re2 of P4 has 1 inner setae (2 in Farran's specimens), and the terminal seta of Re3 of P4 is relatively shorter in the Puerto Rican specimens.

Distribution.—Indian Ocean (Farran, Rosendorn, Tanaka), Suez Canal (Gurney), South China Sea (Tanaka), west of Bay of Biscay (Rosendorn), mouth of Amason River (Rosendorn), west coast of Florida (Grice). In the Puerto Rico collections it was one of the most common species in the bays as well as over the shelf.

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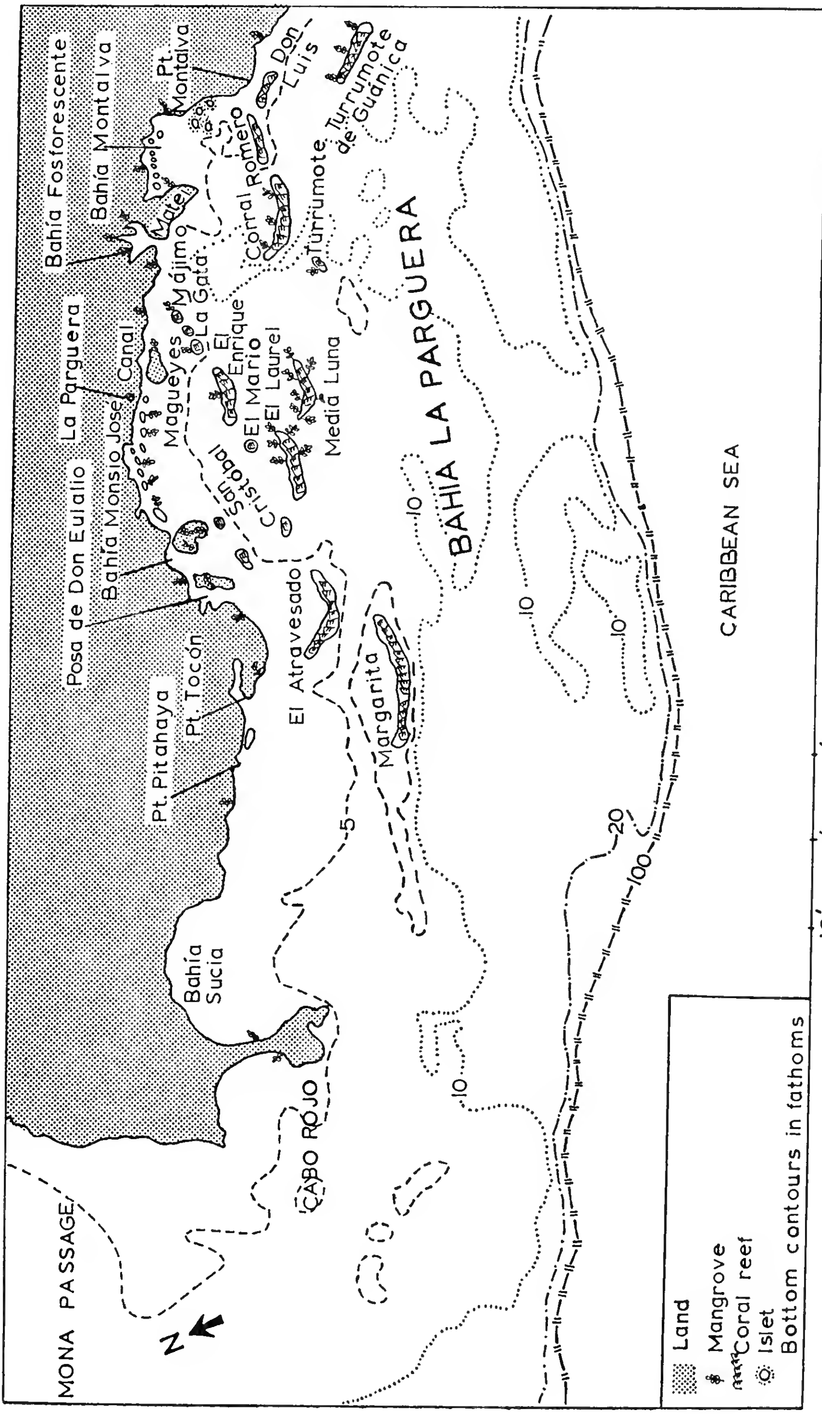


FIGURE 1.—Southwest coast of Puerto Rico, showing region where plankton samples were collected.

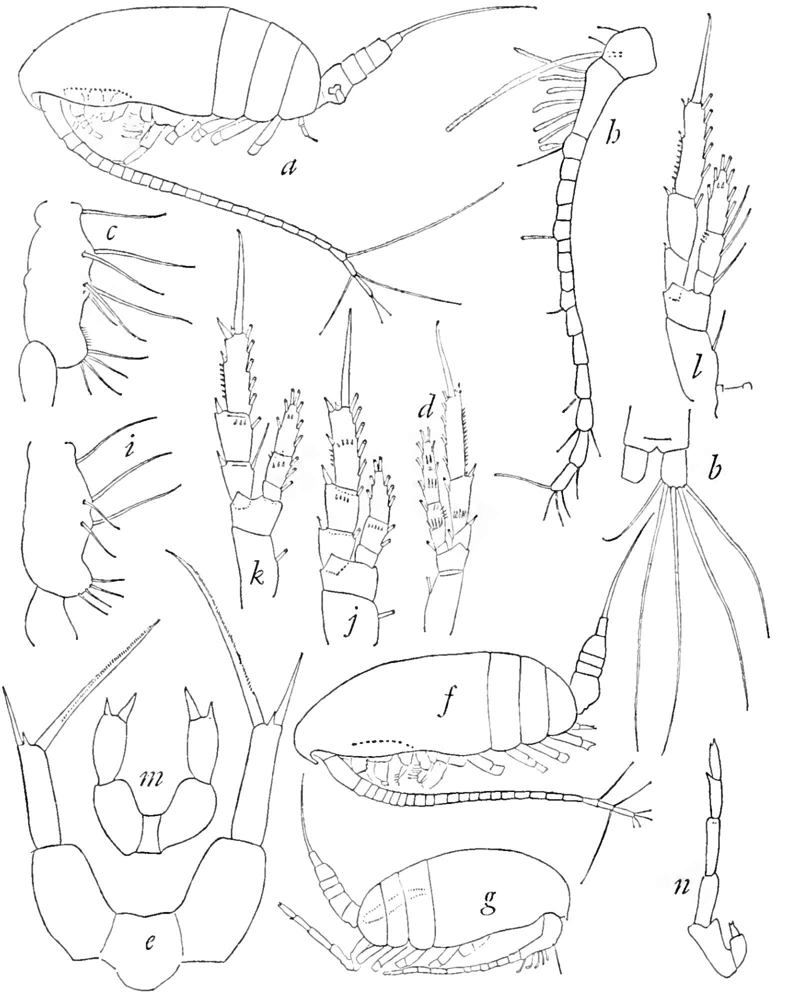


FIGURE 2.—*Paracalanus aculeatus* Giesbrecht, female: *a*, lateral view; *b*, caudal rami, dorsal; *c*, B1 of Mxp; *d*, P4; *e*, P5. *Paracalanus crassirostris* Dahl: *f*, female, lateral; *g*, male, lateral; *h*, right A1, male; *i*, B1 of Mxp; *j*, P2; *k*, P3; *l*, P4; *m*, P5, female; *n*, P5, male.

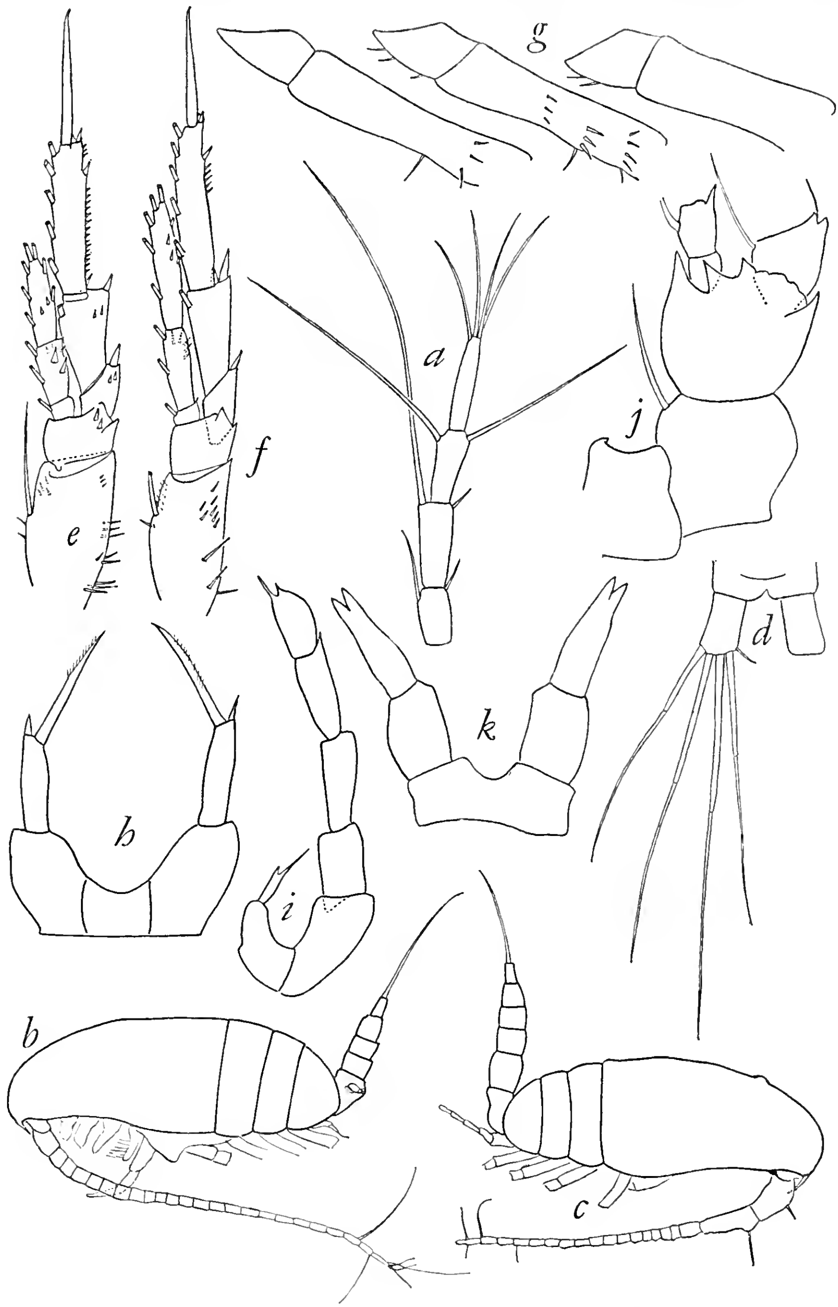


FIGURE 3.—*Paracalanus crassirostris* Dahl: *a*, distal end of A1. *Paracalanus parvus* (Claus): *b*, female, lateral; *c*, male, lateral; *d*, caudal ramus, female; *e*, P3; *f*, P4; *g*, B1 and B2 of P2–P4 (from left to right), lateral; *h*, P5, female; *i*, P5, male. *Clausocalanus furcatus* (Brady), female: *j*, B1 and B2 of P3; *k*, P5.

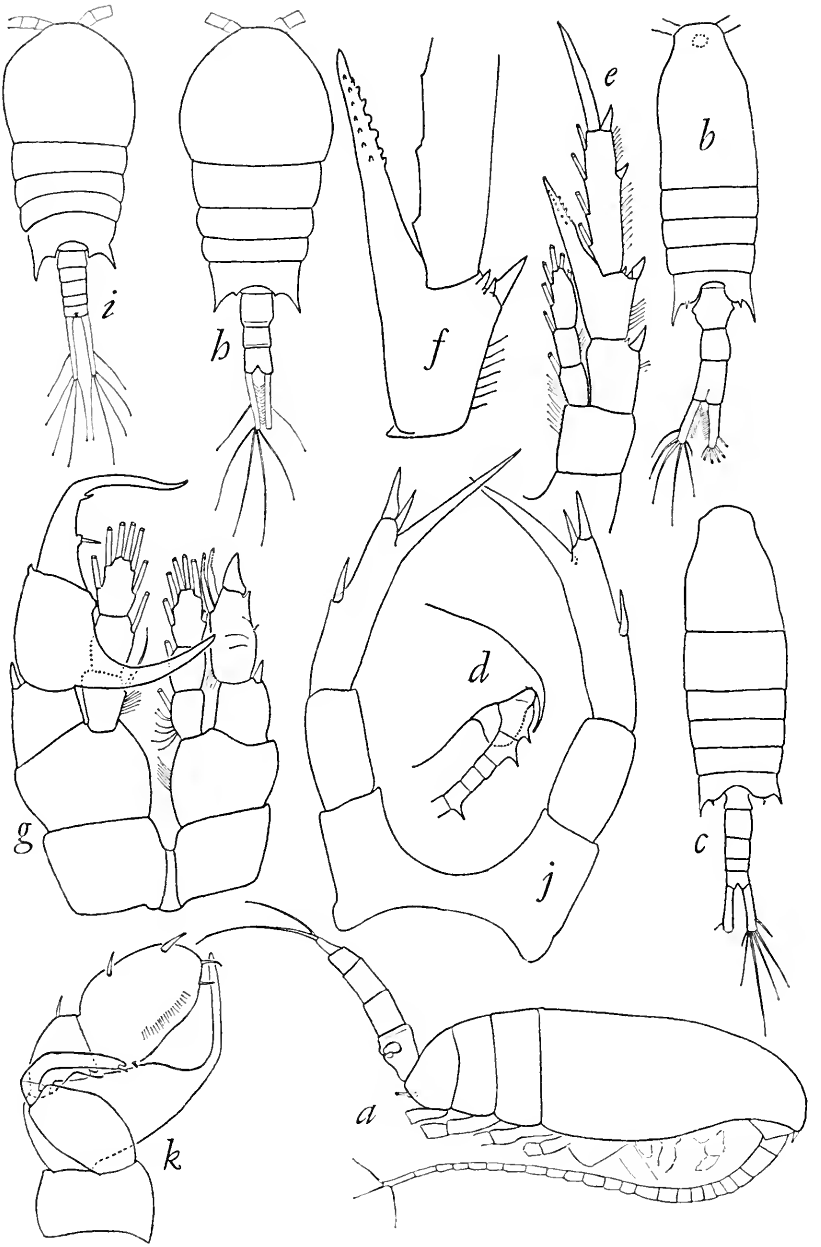


FIGURE 4.—*Clausocalanus furcatus* (Brady): *a*, female, lateral. *Centropages furcatus* (Dana): *b*, female, dorsal; *c*, male, dorsal; *d*, head of female, lateral; *e*, P5, female; *f*, Ri2 of P5, female; *g*, P5, male. *Temora stylifera* Dana: *h*, female, dorsal; *i*, male, dorsal; *j*, P5, female; *k*, P5, male.

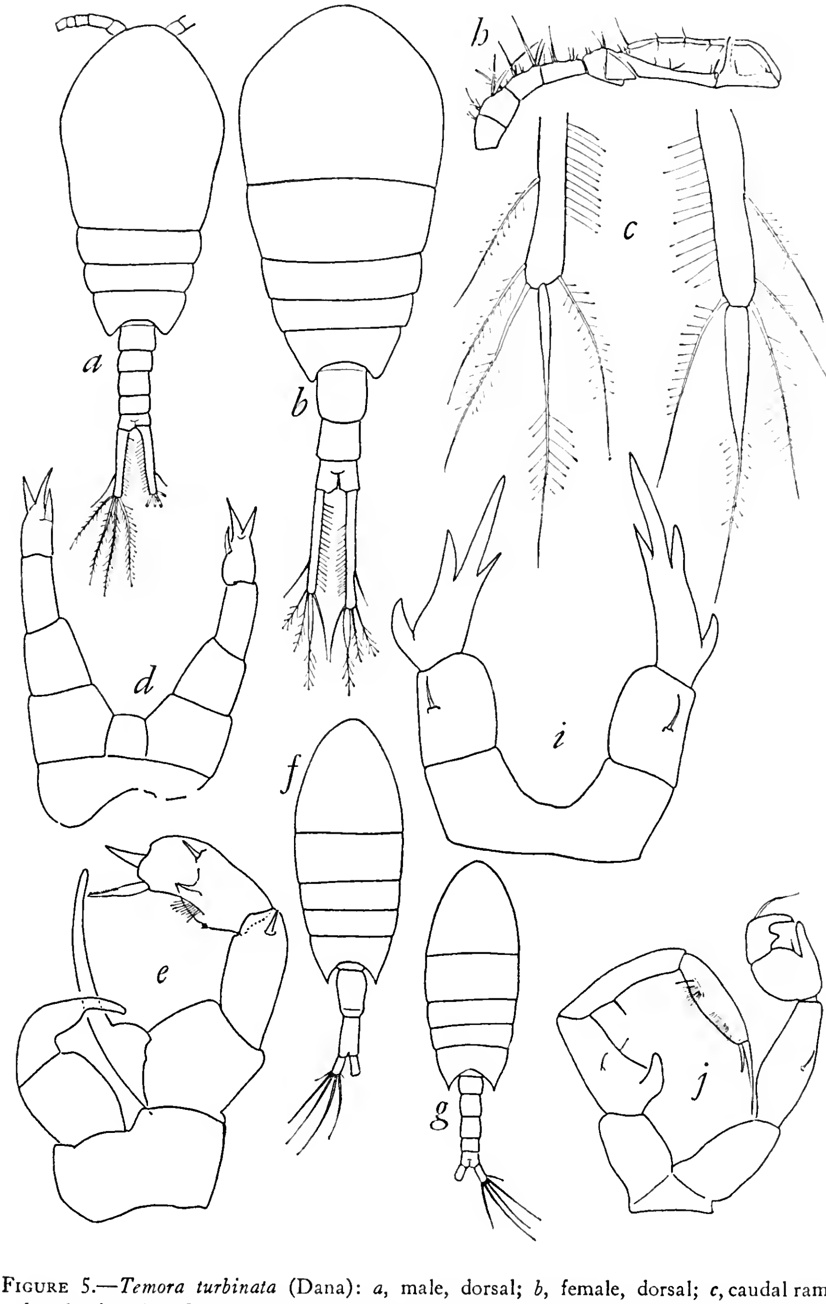


FIGURE 5.—*Temora turbinata* (Dana): *a*, male, dorsal; *b*, female, dorsal; *c*, caudal rami, female, dorsal; *d*, P5, female; *e*, P5, male. *Calanopia americana* Dahl: *f*, female, dorsal; *g*, male, dorsal; *h*, A1, male; *i*, P5, female; *j*, P5, male.

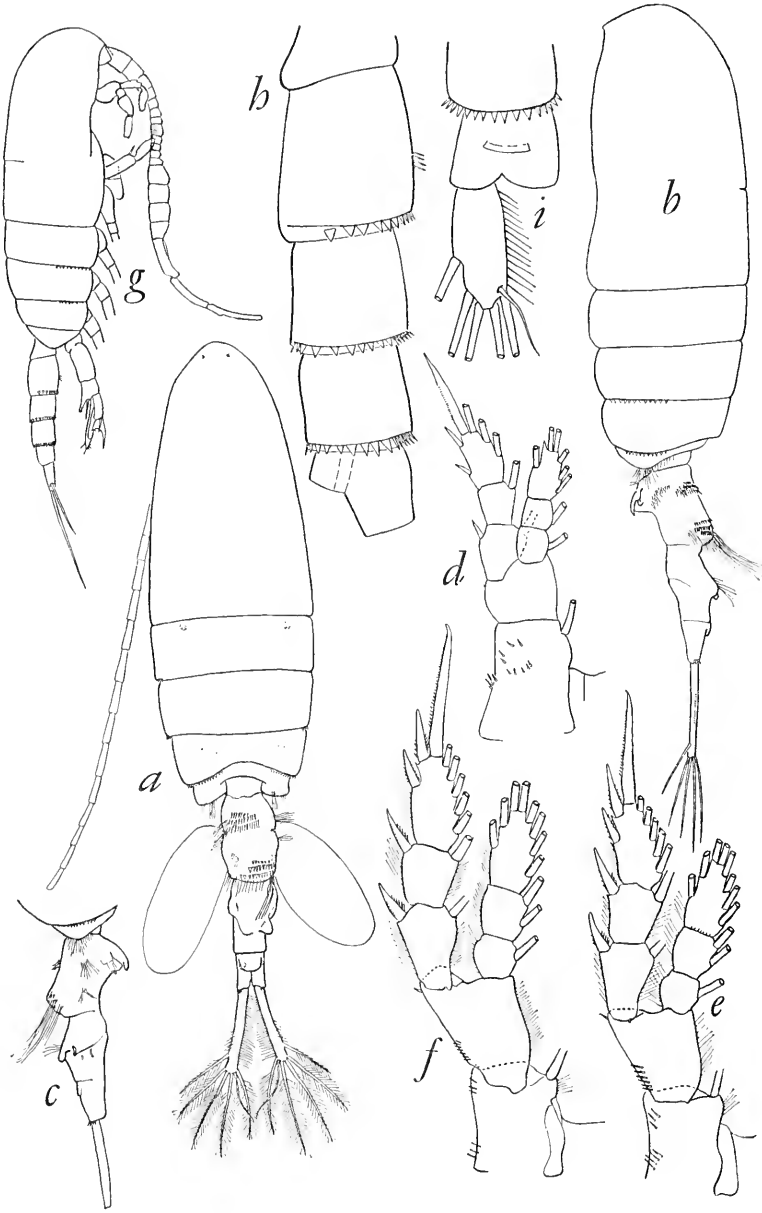


FIGURE 6.—*Pseudodiaptomus cokeri*, new species, female: *a*, dorsal; *b*, lateral; *c*, urosome, right aspect; *d*, P1; *e*, P2; *f*, P3. Male: *g*, lateral; *h*, urosome, lateral; *i*, urosome segments 4–5 and caudal rami, dorsal.

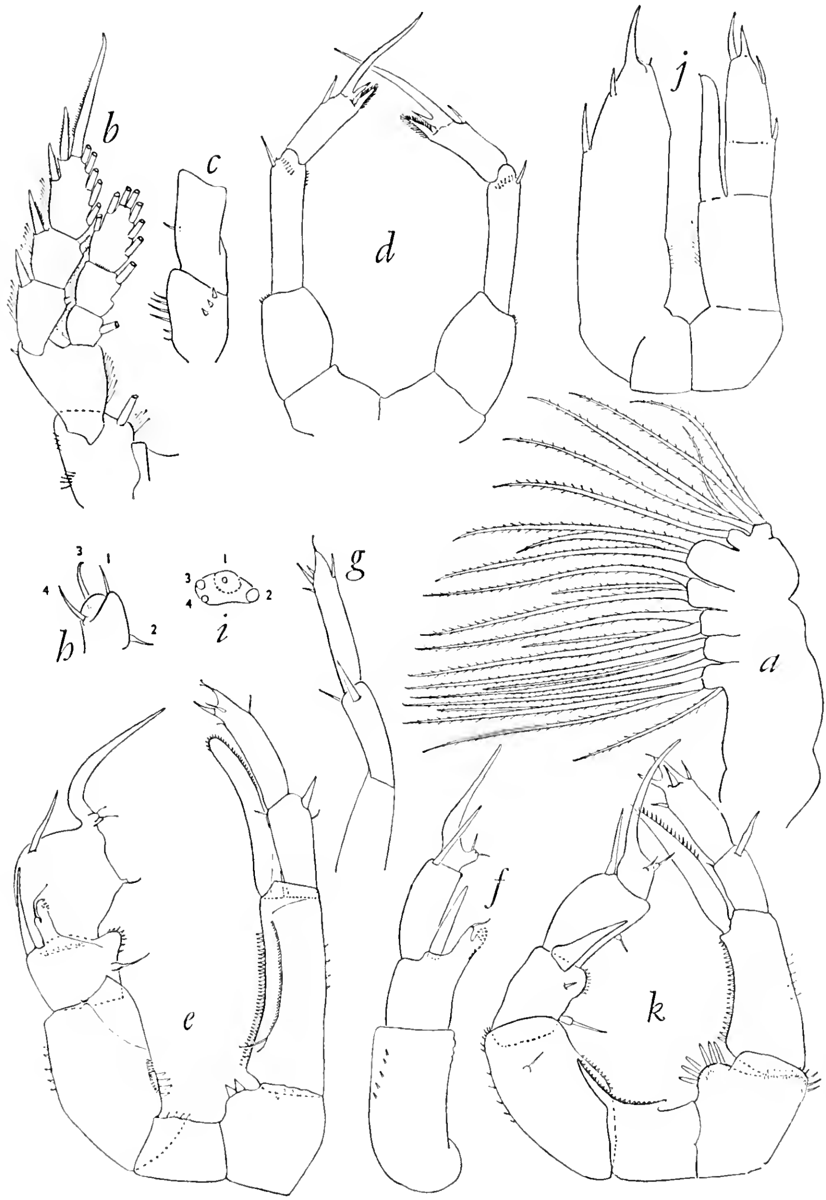


Figure 7.—*Pseudodiaptomus cokeri*, new species: *a*, Mx2; *b*, P4; *c*, B1 and B2 of P4, lateral; *d*, P5, female; *e*, P5, male; *f*, right P5, male, lateral; *g*, left P5, male, lateral; *h*, left P5, male, apex of Re2, posterolateral; *i*, same, plan of setae (1=anterior, 2=lateral, 3–4=medial); *j*, P5, male copepodite V. *Pseudodiaptomus coronatus* Williams: *k*, P5, male.

FIGURE 8.—*Pseudodiaptomus cokeri*, new species: *a*, A1, female; *b*, right A1, male; *c*, A2, female; *d*, Md, female; *e*, Mxp, female.

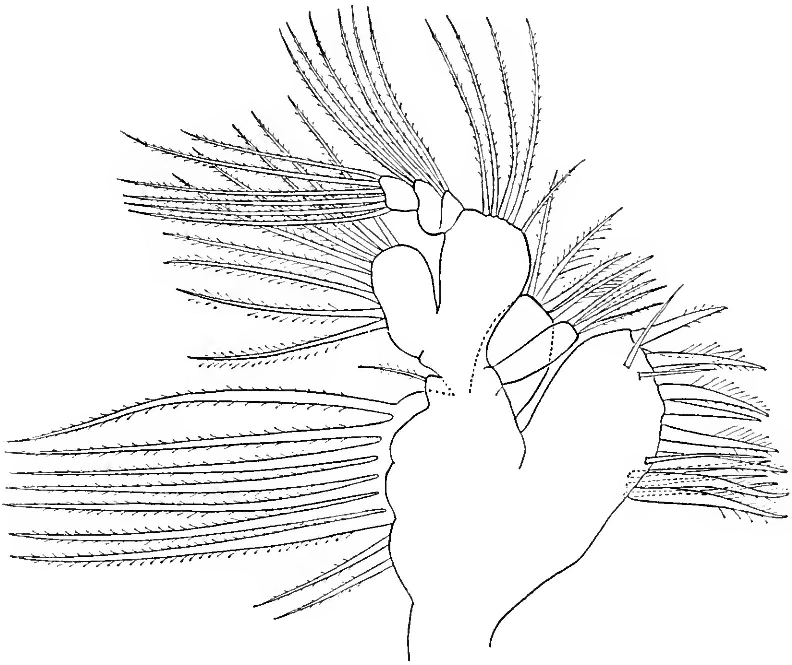
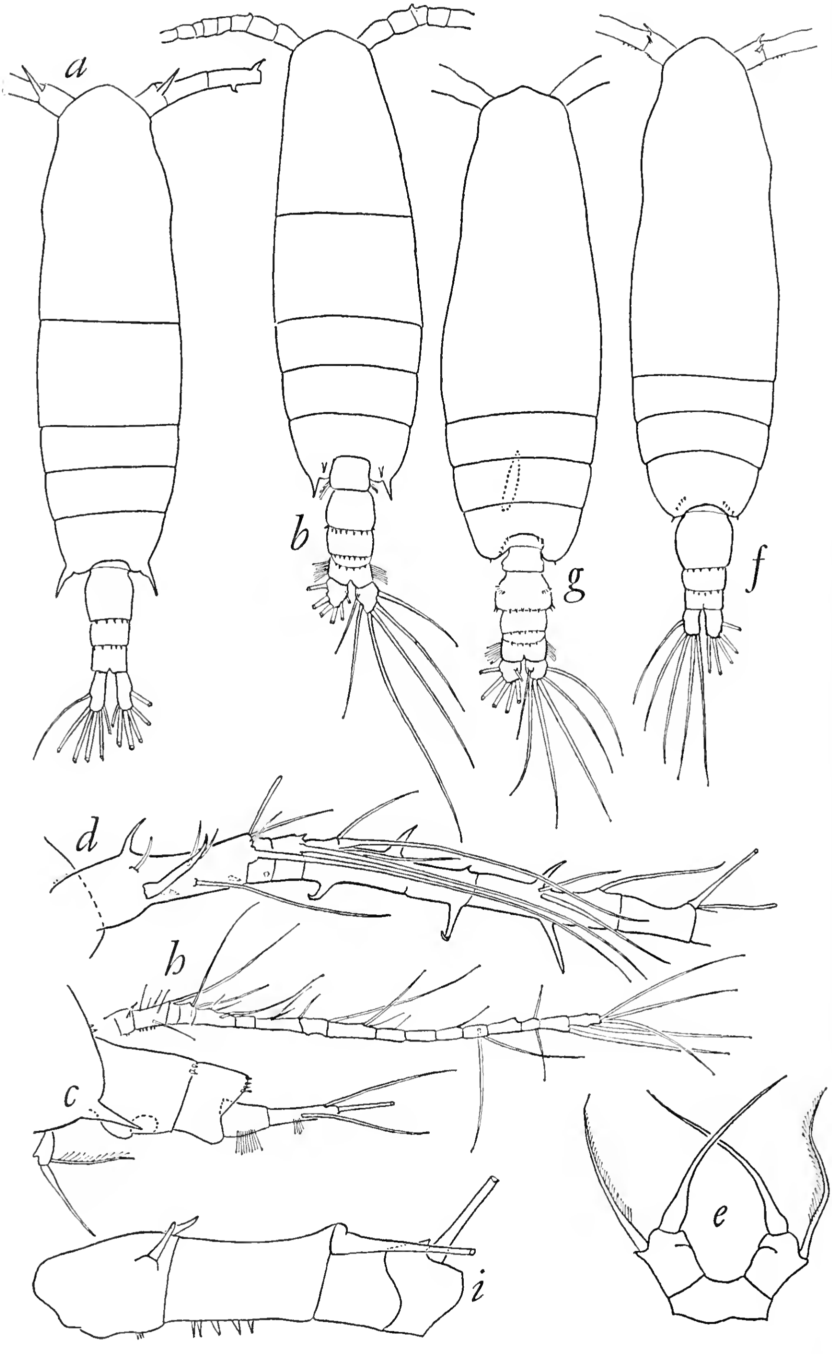


FIGURE 9.—*Pseudodiaptomus cokeri*, new species, female Mx1.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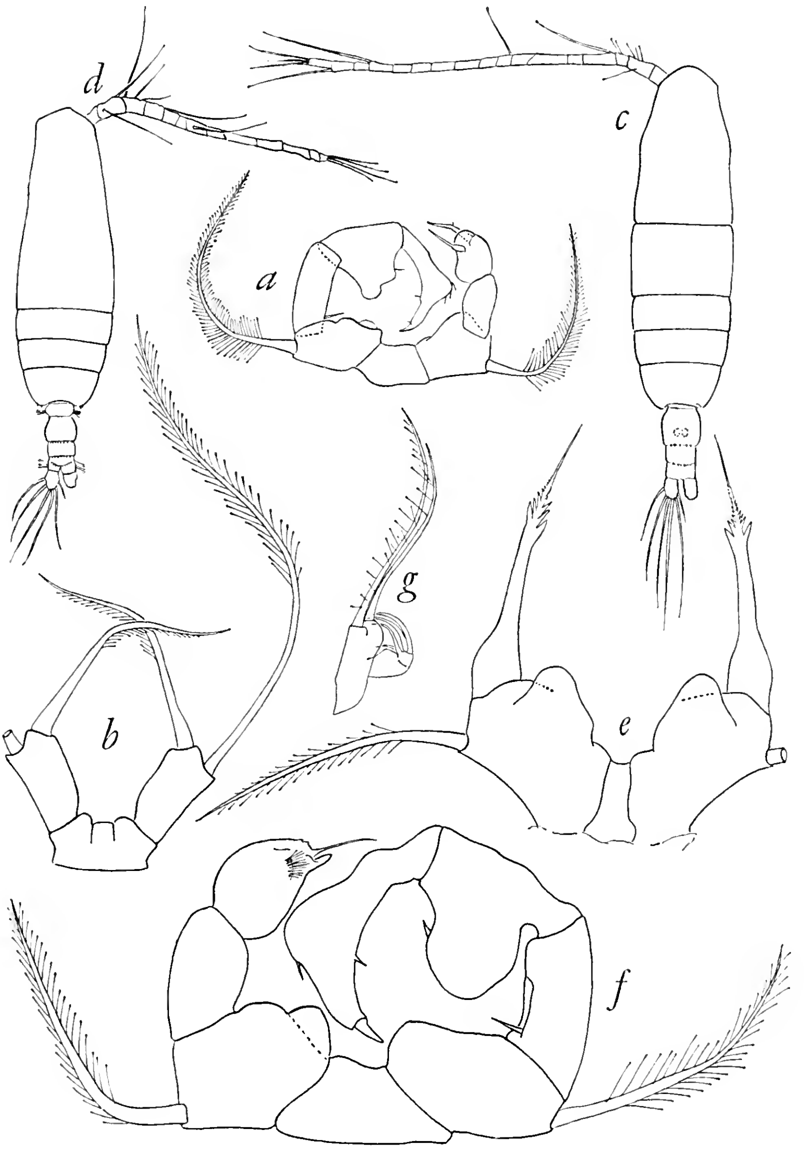

Figure 11.—*Acartia lilljeborgii* Giesbrecht: *a*, P5, male. *Acartia spinata* Esterly: *b*, P5, female. *Acartia tonsa* Dana: *c*, female, dorsal; *d*, male dorsal; *e*, P5, female; *f*, P5, male. *Tortanus compernis*, new species: *g*, Mxp.

Figure 10 (p. 292).—*Acartia lilljeborgii* Giesbrecht: *a*, female, dorsal; *b*, male, dorsal; *c*, PedSeg 5 and urosome of female, lateral; *d*, proximal segments of female A1, ventral; *e*, P5, female. *Acartia spinata* Esterly: *f*, female, dorsal; *g*, male, dorsal; *h*, A1, female; *i*, proximal segments of A1, female.

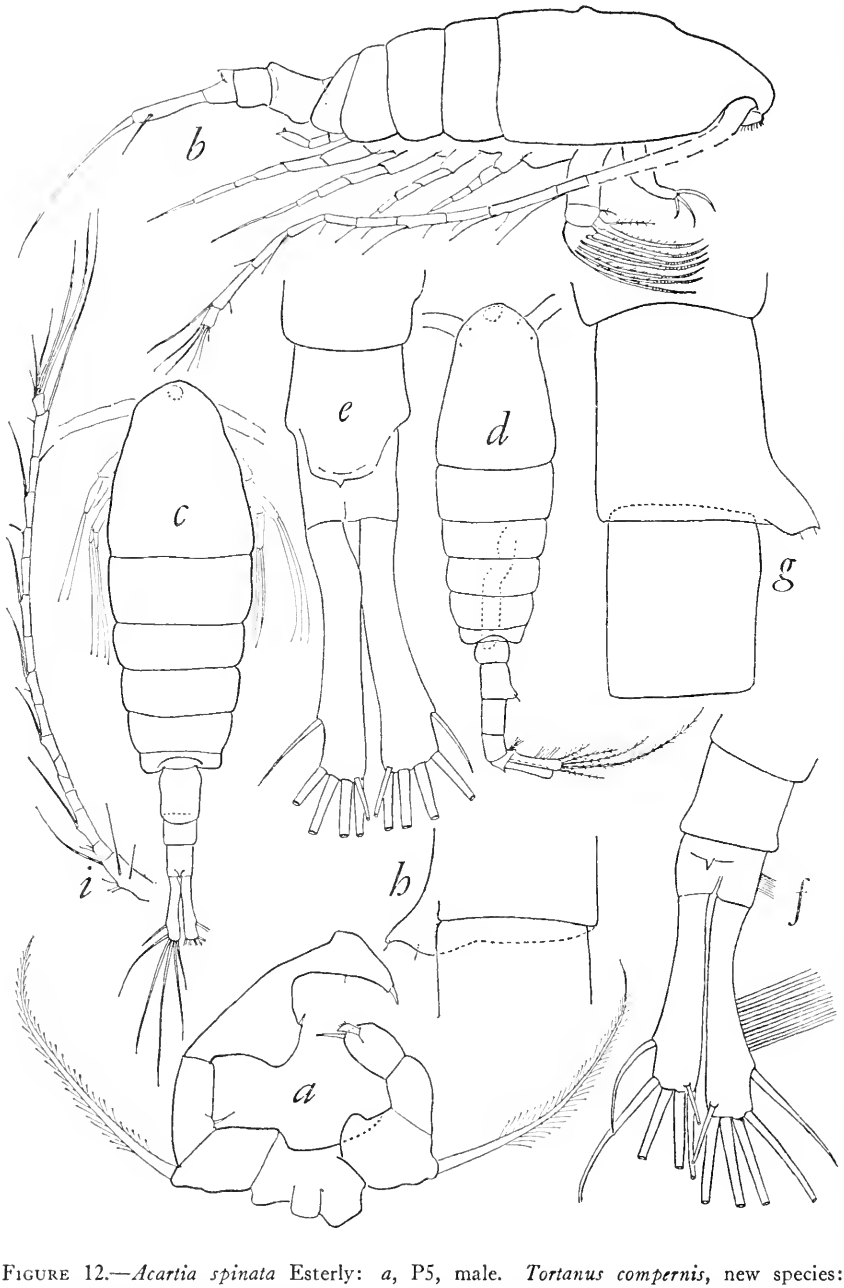

FIGURE 12.—*Acartia spinata* Esterly: *a*, P5, male. *Tortanus compernis*, new species: *b*, female, lateral; *c*, female, dorsal; *d*, male, dorsal; *e*, posterior end of urosome and caudal rami, female; *f*, same, male; *g*, urosome segments 2 and 3, male, dorsal; *h*, posterior part of urosome segment 2, ventral; *i*, A1, female.

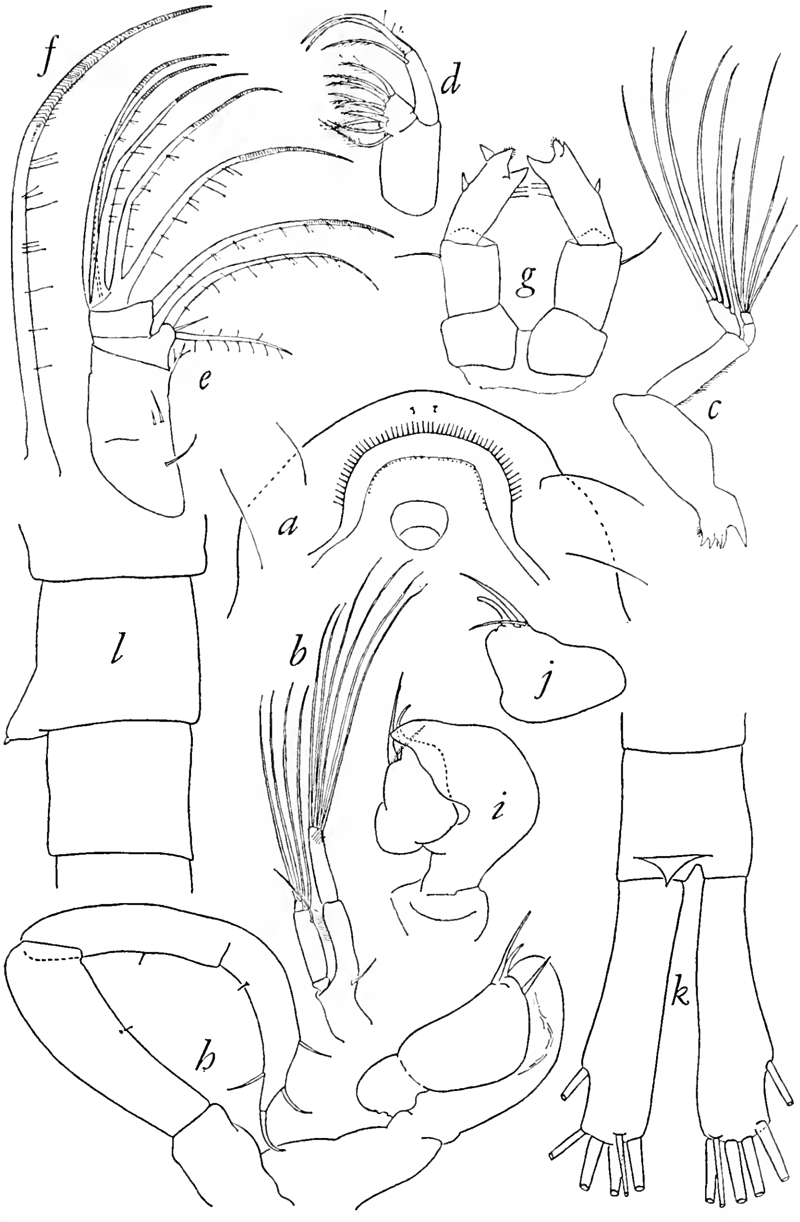

FIGURE 13.—*Tortanus compernis*, new species: *a*, ventral view of head, female; *b*, A2, female; *c*, mandible, female; *d*, Mx1, female; *e*, Mx2, female; *f*, seta of Mx2, female; *g*, P5, female; *h*, P5, male; *i*, right P5, male; *j*, right P5, male, Re1. *Tortanus setacaudatus* Williams, Biscayne Bay, Florida: *k*, anal segment and caudal rami, female, dorsal; *l*, urosome segments 2 and 3, male, ventral.

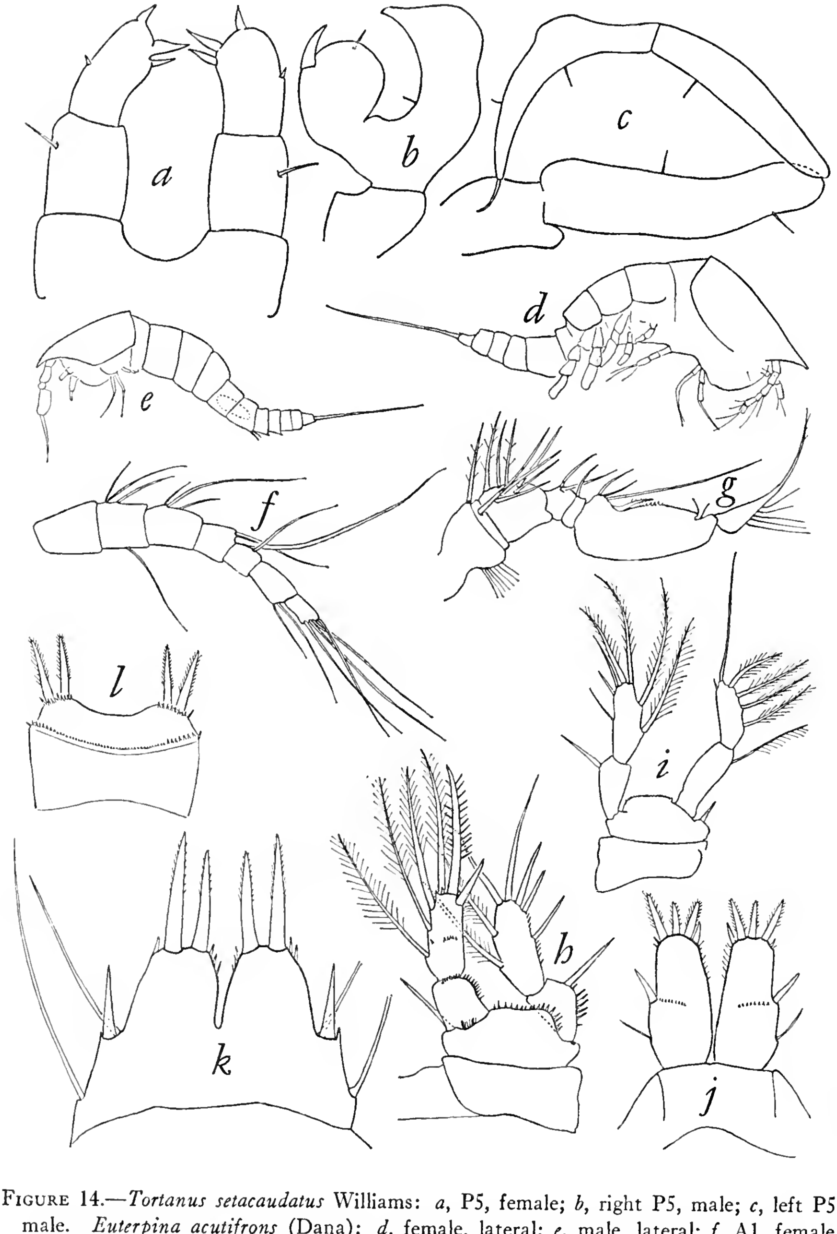

FIGURE 14.—*Tortanus setacaudatus* Williams: *a*, P5, female; *b*, right P5, male; *c*, left P5, male. *Euterpina acutifrons* (Dana): *d*, female, lateral; *e*, male, lateral; *f*, A1, female; *g*, A1, male; *h*, P1, female; *i*, P1, male; *j*, P5, female; *k*, P5, male; *l*, P6, male.

FIGURE 15.—*Longipedia helgolandica* Klie: *a*, female, dorsal; *b*, female, lateral; *c*, last 2 urosome segments and caudal rami, female, dorsal; *d*, A1, male; *e*, Md, gnathal lobe, female; *f*, P1, female; *g*, P2, female; *h*, P3, female.

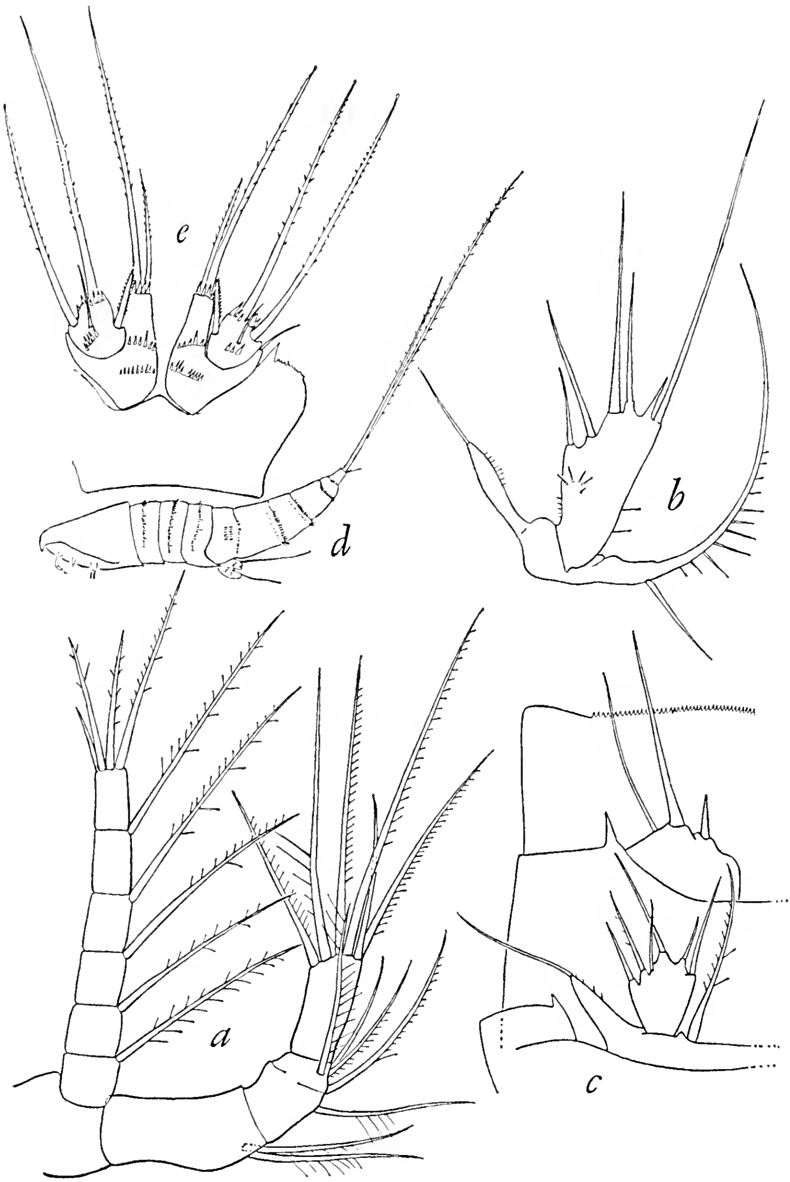

FIGURE 16.—*Longipedia helgolandica* Klie: *a*, A2, female; *b*, P5, female; *c*, P5 and P6 in situ, male. *Microsetella norvegica* (Boeck): *d*, female, lateral; *e*, P5, female.

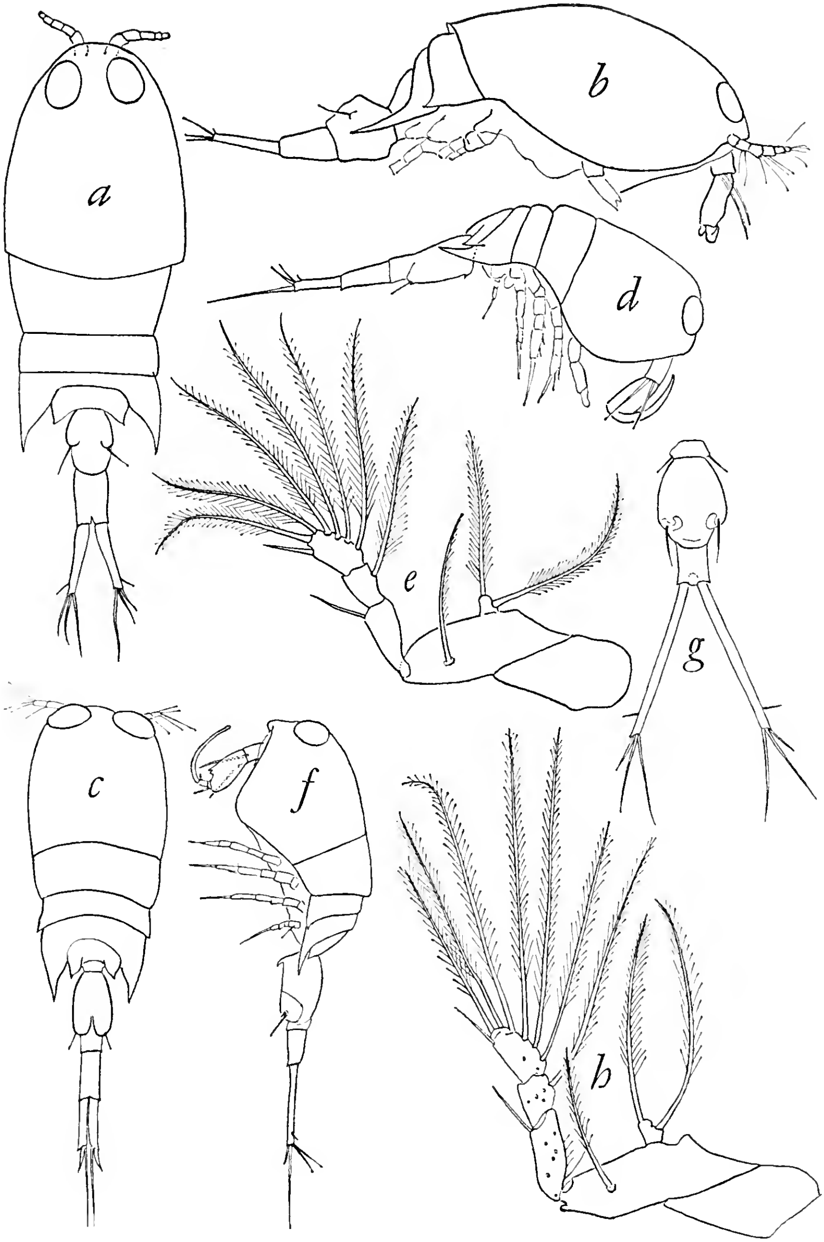

FIGURE 17.—*Corycaeus amazonicus* Dahl: *a*, female, dorsal; *b*, female, lateral; *c*, male, dorsal; *d*, male, lateral; *e*, P4, female. *Corycaeus subulatus* Herrick: *f*, male, lateral; *g*, male urosome, dorsal; *h*, P4, female.

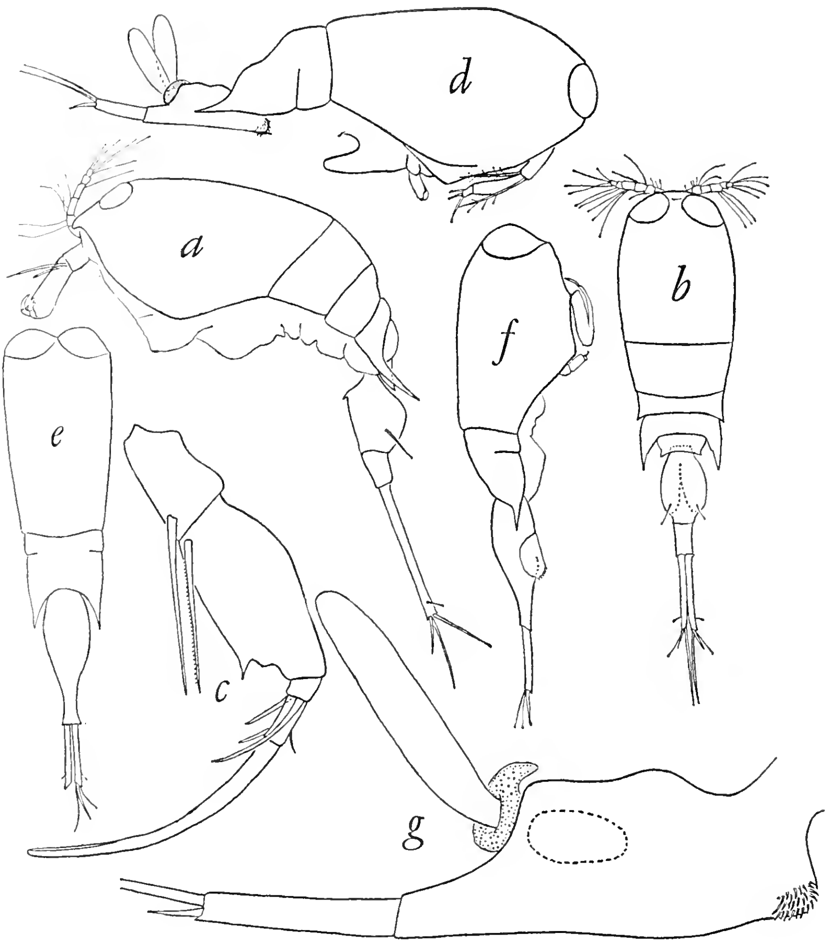

FIGURE 18.—*Corycaeus subulatus* Herrick: *a*, female, lateral; *b*, male, dorsal; *c*, A2, male. *Farranula gracilis* (Dana): *d*, female, lateral; *e*, male, dorsal; *f*, male, lateral; *g*, female urosome, lateral.

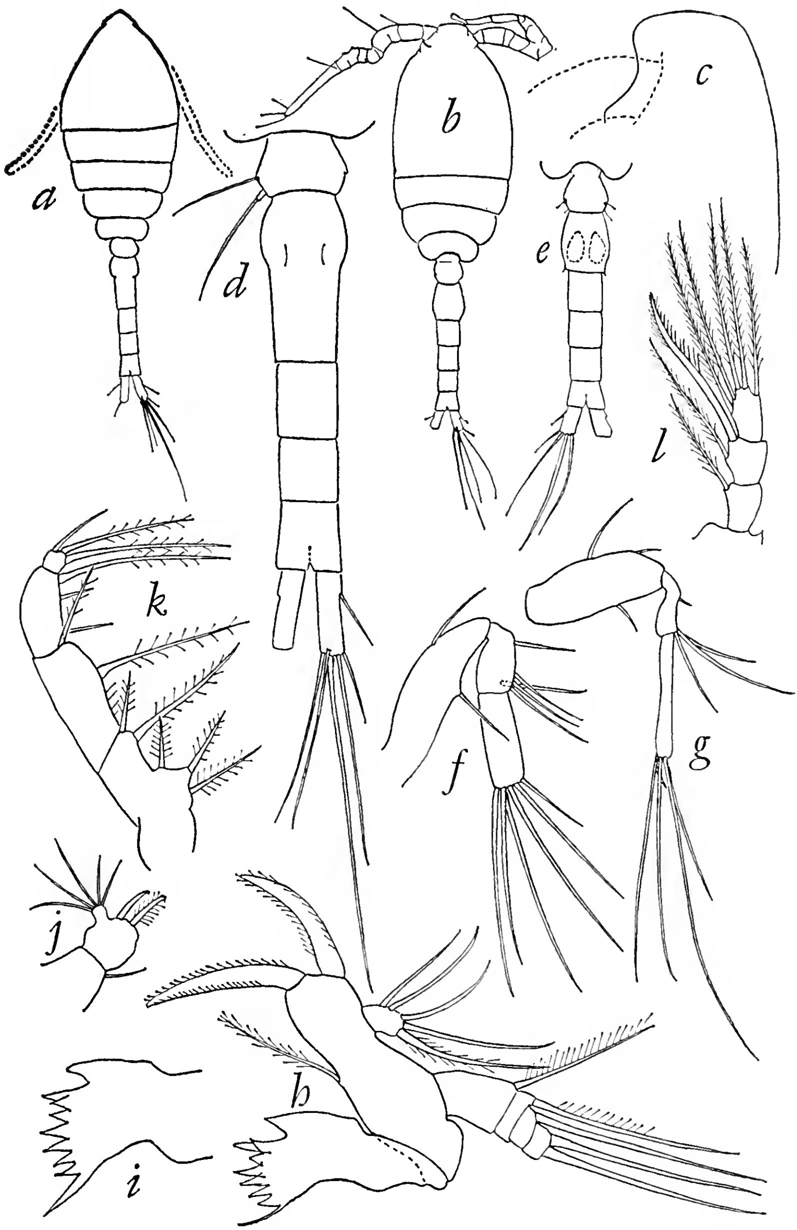

FIGURE 19.—*Oithona hebes* Giesbrecht: *a*, female, dorsal; *b*, male, dorsal; *c*, female head, lateral; *d*, female urosome, dorsal; *e*, male urosome, dorsal; *f*, A2, female; *g*, A2, male; *h*, Md, female; *i*, Md, gnathal lobe, female; *j*, Md, B2, male; *k*, Mxp, male; *l*, P4, female.

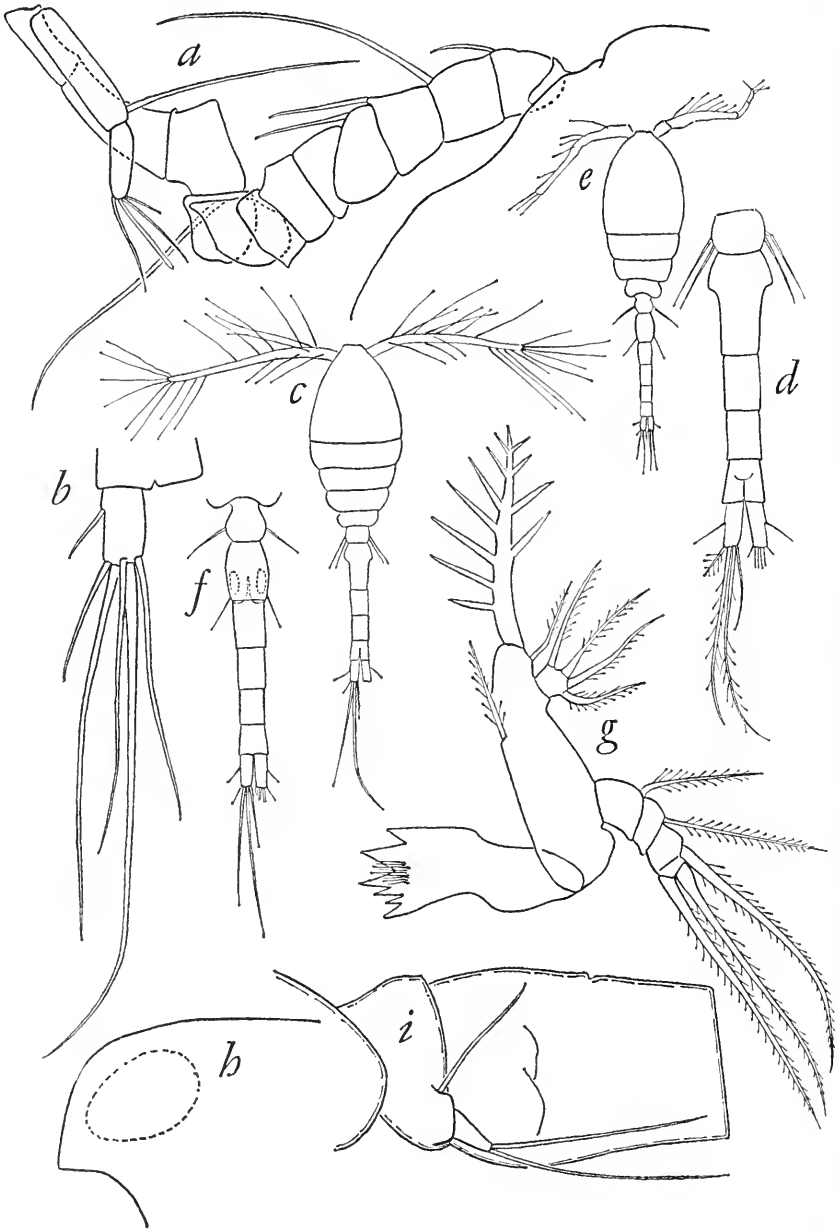

FIGURE 20.—*Oithona hebes* Giesbrecht: *a*, A1, male; *b*, left caudal ramus, female from Guayaquil, Ecuador. *Oithona nana* Giesbrecht: *c*, female, dorsal; *d*, female urosome, dorsal; *e*, male, dorsal; *f*, male urosome, dorsal; *g*, Md, female. *Oithona oculata* Farran: *h*, female head, lateral; *i*, urosome segments 1–2, female, lateral, showing P5.

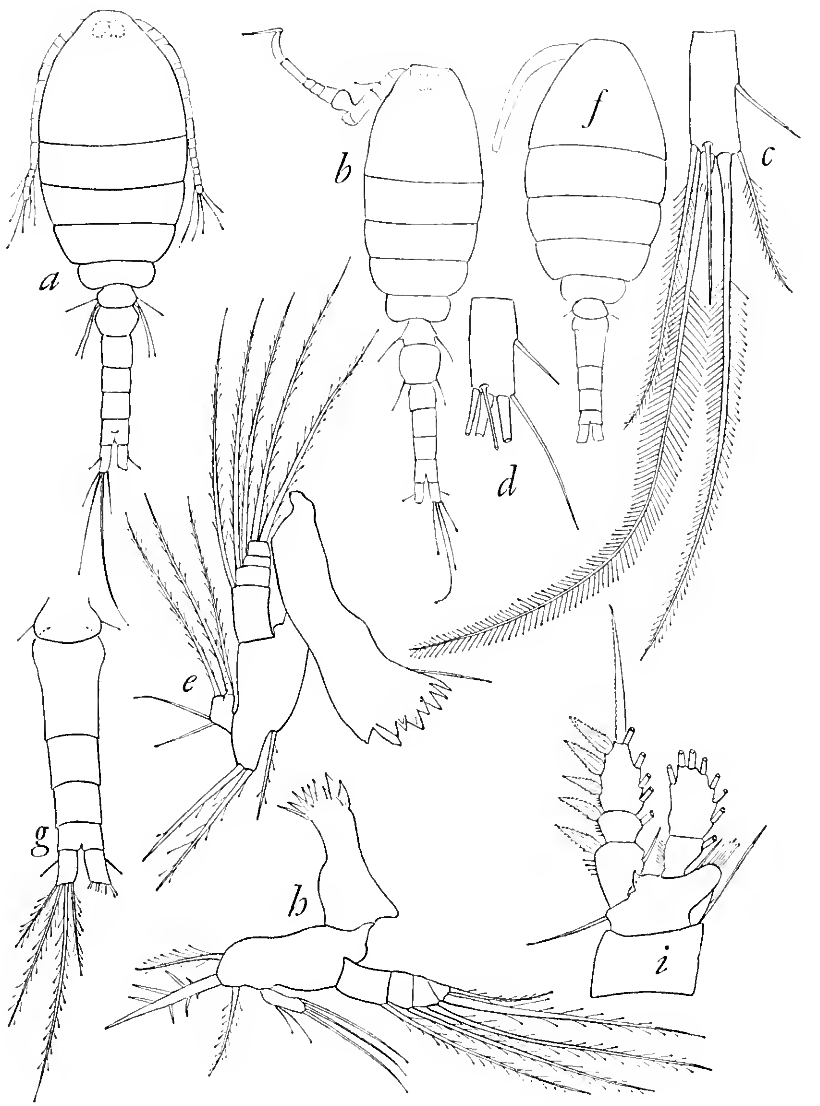

FIGURE 21.—*Oithona oculata* Farran: *a*, female, dorsal; *b*, male, dorsal; *c*, right caudal ramus, female; *d*, right caudal ramus, female from Ifaluk Atoll, Caroline Islands; *e*, Md, female. *Oithona simplex* Farran: *f*, female, dorsal; *g*, female urosome, dorsal; *h*, Md, female; *i*, P1, female.

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REVISION OF THE MILLIPED GENERA BORARIA AND GYALOSTETHUS (POLYDESMIDA: XYSTODESMIDAE) [1]

By Richard L. Hoffman [2]

Introduction

The present paper is the sixth part of a monographic study of the diplopod family Xystodesmidae begun in 1956. In recent years, largely through the efforts of Leslie Hubricht, the quantity of available study material in this group has been increased vastly and the preparation of additional generic synopses correspondingly has been accelerated. Completion of the series is anticipated within the next four years.

The two genera considered in the following pages belong to a group that has been recognized recently (Hoffman, 1960) as the tribe Rhysodesmini. Species of this tribe are of interest in their departure from the usual xystodesmid structural relationships. Normally in this family species differ chiefly in gonopod form; here the various species differ strikingly in body structure while the gonopods remain essentially similar even among different genera. This condition is particularly true of the nominal genera centered around *Rhysodesmus*

[1] Studies supported by grants (G-9805 and G-21519) from the National Science Foundation.

[2] Radford College, Radford, Va.

such as *Cruzodesmus*, *Acentronus*, *Cibularia*, *Howellaria*, *Stenodesmus*, and *Boraria*, which are distinguished by apparently trivial characters of the gonopods that scarcely would be considered as specific in genera such as *Nannaria*, *Brachoria*, and *Sigmoria*.

It, therefore, becomes necessary to rely heavily upon nonsexual characters in the definition of rhysodesmine genera and, furthermore, to utilize a variety of characters taken in combination to achieve this purpose. As a result, generic distinctions are perhaps more subtle than usual but certainly of equal importance with single gonopod characters such as those which separate *Apheloria* from *Brachoria* or *Pachydesmus* from *Dicellarius*.

Students of the Diplopoda who regard gonopodal characters as the sine qua non for generic recognition may disagree with this point of view, and so it may be well to restate my conviction that characters of taxonomic importance vary considerably from one group to another and that we must judge each group on its own merits and not by the rigid application of some traditional Procrustean formula. A colleague, C. A. W. Jeekel, has expressed to me the opinion, with which I agree entirely, that, from the taxonomic point of view, small variations in the shape of a basically simple gonopod may well be as significant as large-order variations affecting more complex gonopods. I think that this view applies very aptly to the Rhysodesmini. In a future paper, now in preparation, I shall consider the genera of Mexico and the western United States, the classification of which, I might add, is in a state of the greatest confusion. The present paper treats four species of the eastern United States that have been referred to the genera *Boraria* and *Howellaria*.

Review of the literature.—The first species of *Boraria* to have been described scientifically was collected in western North Carolina by the arachnologist Eugene Simon and was named by H. W. Brolemann (1896) as *Fontaria tennesseensis* var. *stricta*. Four years later, realizing that *stricta* was not related closely to Bollman's species *tennesseensis*, Brolemann raised his form to the rank of a full species of *Fontaria*. Despite the good (and readily available) original description, this name fell into obscurity until 1958[3] when it was resurrected and allocated to *Boraria* (Chamberlin and Hoffman, 1958).

In 1918, R. V. Chamberlin named another Appalachian form under the combination *Nannaria media*. Since the description of *N. media* did not include illustrations of the gonopods, this form promptly fell

[3] Graf Attems was of course cognizant of the name *stricta* but did not mention it in print between 1899 (as *Fontaria stricta*) and 1938, when he referred it to the genus *Rhysodesmus*.

into obscurity along with *F. stricta* and was not mentioned again in the literature for more than 30 years.

Twenty years later, Dr. Chamberlin set up the new genus *Aporiaria* for a new species, *texicolens*, from southern Texas, without stating how either of these taxa differed from a variety of existing genera and species. In the following year (1939), Dr. Chamberlin published a brief but important paper in which numerous new genera and species were described from the eastern United States. Two of these species were published in *Aporiaria* as *A. carolina* and *A. geniculata*, both coming from western North Carolina. Neither was compared with any of the small xystodesmids already known from that region.

Several contributions from Chamberlin's pen appearing in 1943 contain major changes and additions to the system. In the first (1943a), the two new species *Aporiaria fumans* and *A. brunnior* were described from eastern Tennessee. The second paper (1943b) contains the information that *Aporiaria texicolens* is a typical species of *Rhysodesmus* and that, consequently, *Aporiaria* must be synonymized under the older name *Rhysodesmus*. Dr. Chamberlin observed, however, that the eastern species described in *Aporiaria* actually are not congeneric with *texicolens*, and for them he proposed the new genus *Boraria* with *Aporiaria carolina* as the type species.

Prior to the publication of the name *Boraria*, Nell B. Causey (1942) had described *Aporiaria deturkiana*, a rather aberrant species from western North Carolina. Somewhat later, I (1950) designated *A. deturkiana* as the type of the new genus *Howellaria*, which I think must now be relegated to the synonymy of *Boraria*.

In February of 1949, I studied the type series of *Nannaria media* in the Museum of Comparative Zoology, and the species was brought into its correct genus in the following year (Wray, 1950).[4]

The following list of names, arranged chronologically and cited by their original combinations, summarizes the foregoing history:

Fontaria tennesseensis var. *stricta* Brolemann, 1896 (North Carolina)
Nannaria media Chamberlin, 1918 (Tennessee)
Aporiaria carolina Chamberlin, 1939 (North Carolina)
Aporiaria geniculata Chamberlin, 1939 (North Carolina)

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[4] The original manuscript for the Class Diplopoda in Dr. Wray's second supplement to the "Insects of North Carolina" was supplied by me with the nomenclature up-to-date and correct as of early 1950. Before publication, however, my list was changed and incorrect combinations and nomina nuda were introduced to the extent that I do not believe that, as published, it should be considered as written by me. It seems preferable to credit the material in question to the authorship of Dr. Wray, even though new nomenclatorial material from my own research is included.

Aporiaria deturkiana Causey, 1942 (Tennessee)
Aporiaria fumans Chamberlin, 1943a (Tennessee)
Aporiaria brunnior Chamberlin, 1943a (Tennessee)
Boraria monticolens Chamberlin, 1951 (Tennessee)

MATERIALS.—Of the four species admitted as valid in the following pages, I have examined approximately 218 specimens, the majority of which were obtained either by me or by Leslie Hubricht. Some additional material, including type specimens, was examined either at the particular museum or by loan from several museum collections, all of which are indicated by the following abbreviations:

AMNH—American Museum of Natural History, New York
ANSP—Academy of Natural Sciences, Philadelphia
MCZ—Museum of Comparative Zoology, Cambridge
RVC—R. V. Chamberlin collection, University of Utah, Salt Lake City
USNM—United States National Museum, Washington

The adequacy of any revisionary work on millipeds is known to be largely a direct result of the study of typical material. I have been fortunate in being able to see some kind of type for all but one of the names of the foregoing list.

holotypes	paratype
Aporiaria geniculata (RVC)	*Fontaria stricta* (USNM)
Aporiaria deturkiana (ANSP)	topotype
Nannaria media (MCZ)	*Aporiaria carolina* (RLH)

No typical material of *Aporiaria brunnior* has been seen; this name is allocated tentatively on the basis of its published description.

Friends and colleagues who kindly loaned specimens from collections under their care or who permitted the examination of material at various museums include the following: Ralph E. Crabill, Jr., P. J. Darlington, W. J. Gertsch, and J. A. G. Rehn. I owe a particular note of thanks to Dr. Ralph V. Chamberlin for his generous loans of type specimens and to Prof. Max Vachon, who kindly exchanged a male paratype of *Fontaria stricta* from the Museum National d'Histoire Naturelle de Paris.

Much of my field work, prior to 1962, was made possible by financial assistance from the Highlands [North Carolina] Biological Station. I am under a continuing debt to numerous friends who have assisted in collecting or who independently have picked up millipeds for me. The name of Leslie Hubricht continues to head this roster.

Drawings have been made with a binocular microscope fitted with an ocular recticule. Measurements of length were taken to the nearest whole millimeter; those of width, to the nearest tenth of a millimeter with a vernier-scale calipers.

All of the localities mentioned may be located in the "Rand-McNally Commercial Atlas of the United States."

Taxonomic Characters

As in preceeding papers in this series, I wish to preface the taxonomic treatment with a consideration of various structural characters that have been found useful in the separation of genera and species or in the recognition of similarities between such taxa. The following account may appear somewhat extended, but this is due to the fact that it contains both the description and evaluation of the characters involved; also, it is due to the fact that, in some cases, I can now attempt the classification of certain features, such as the sterna as they occur in the Xystodesmidae at large and not just as they occur in the genera discussed in this paper.

It is patently impossible to utilize, for practical taxonomic purposes, all of the points of similarity and difference that can be recognized in groups of related species. I think, however, that in diplopod systematics we should go beyond mere "key characters"—at least in formal descriptions or definitions of species. The present consideration of sexual dimorphism is a case in point, for even though series of both males and females may be needed to establish the extent of size or proportion of dimorphism, the phenomenon itself is certainly a valid part of the makeup of many species and, therefore, should be taken into account. We need not rely upon the stronger dimorphism of *Boraria deturkiana* to separate that species from *B. media,* but it is nonetheless a point of difference and one which is useful in determining comparative levels of divergence in this genus. The same point might be made for differences in life history, habitat preferences, and so on, when this information becomes available.

Body form.—The relative proportions of the body offer useful comparative data on relationships of species even though they may not be of immediate value in identifying individual specimens. One factor which influences the mensural proportions is the degree of development of the paranota: specimens with well-developed paranota naturally appear much broader in relation to the body length, and this is reflected in the ratio of width divided by length (referred to hereinafter as the W/L ratio). Normally males tend to have a higher ratio since the paranota are larger in comparison to the diameter of the segmental body cavity. This is not always true, however, and among the species here considered, the ratio tends to be about 1% greater in females. The ratio is not obtainable with a high degree of accuracy since the length of preserved specimens is difficult to determine, but with a little practice one can at least secure uniform

measurements. This matter is discussed in some detail in my previous paper (1960) on *Cherokia*. The range of variation in the W/L ratio in small series runs about 2% at the most. Part of this is due to measurement errors, part to normal variability in the species. To illustrate the specific differences, I give here a list of the four species described herein, with the average W/L ratio for males in terms of percentages:

Boraria stricta 17.5	*Boraria deturkiana* 19.4
Boraria media 20.4	*Gyalostethus monticolens* 22.1

STERNA.—The metazonal sternal areas, unless produced into conspicuous subcoxal spines, have been generally disregarded by previous workers on the Xystodesmidae, yet during the past few years I have come to consider the sterna of paramount importance in the classification of this family. In a previous paper (1958) I proposed the anatomical term podosternum to describe the form occurring in the genus *Pachydesmus*, and I can now outline a rough classification of easily distinguishable variations. Generally speaking, the sternal areas are much the same in both sexes, except for being proportionately wider in females, and tend to be much the same in most or all members of a given genus. We can consider, therefore, the sterna to be usually generic in value as regards their systematic utility.

(a) Unmodified: In essentially unmodified sterna, the coxae are attached to slight subcoxal elevations, there is no tendency for the development of subcoxal spines, and usually such sterna are glabrous. Normally the central area of each sternum is about the same elevation as the adjoining part of the prozonite, and the interzonal furrow or suture is thus not immediately followed by a raised surface. The caudal edge of the metasternum is preceded by a flat margin, which usually becomes wider at the midventral area. This type of sternum occurs in *Boraria, Dixioria,* and some other genera.

(b) Bilobed: In this category, the sternal surface slopes upward from the interzonal suture, often is interrupted partially by a transverse groove originating between the two pairs of legs, and culminates in two broad obtuse lobes located between the coxae of the posterior pair. Usually there is a short transverse row of setae between the anterior legs, and an irregular field of setae on the lobes. In extreme forms of this type, the posterior lobes may become produced into acute subcoxal spines, and the sternal surface between them forms a thin transverse edge that may overhang the true ventral edge of the segment. Genera with this kind of sternum include *Cherokia, Rhysodesmus, Cleptoria, Dynoria,* and *Sigmoria.*

(c) Spined: In spined sterna, the surface is not elevated above

that of the prozonite or is but slightly so, and there are no lobations between the posterior coxae. Instead, the sternum is produced into acute, often curved, subcoxal spines that include the ventral coxal condyle. This form occurs most characteristically in *Nannaria.*

(d) Podosterna: In a few xystodesmid genera (and in genera of other families) the metasternum is elevated sharply and prominently, the anterior face of this elevation sometimes being perpendicular to the surface of the prozonite. The legs thus appear to be set on the lateral sides of ventral tumidities. There is no tendency for the formation of subcoxal spines or transverse grooves. This type of sternum occurs in *Pachydesmus* and *Dicellarius* in almost indistinguishable form, and this similarity is reinforced by numerous other structural concordances among members of these two genera.

(e) Excavate: In this type, the sterna become proportionately very broad and the surface between the posterior legs is depressed deeply and conspicuously. There is no formation of subcoxal spines. The posterior edge of the metasternum takes the form of a transverse ridge or rim bounding the depression. I know this sternal form only in *Gyalostethus;* presumably it is a rare type of specialization.

I judge that the sterna are less liable to change than the gonopods, and, therefore, provide useful criteria for the determination of affinities as well as a means of identifying female specimens.

In the three species here referred to *Boraria,* the sterna are unmodified while those of *Gyalostethus monticolens* are totally different in formation. This in itself would be sufficient prima facie evidence for generic segregation of *G. monticolens.*

Coxal spines.—Previously the presence or absence of distal spines on the basalmost podomere has been considered to be of generic importance. I have found this character to be a mutable one, however; in some genera (*Dixioria, Boraria, Rhysodesmus*) the coxal spines may be present or absent. There is no trace of them in *B. stricta* and *B. media,* but *B. deturkiana* has prominent spines, and, partly for this reason, I segregated the species into a separate genus some years ago. Apparently this character varies among different groups and may be consistent in some, mutable in others.

Tergal sculpture.—The species treated here are mostly smooth dorsally. *B. stricta* is an exception; the metatergites are provided with several transverse rows of distinct, setiferous tubercules that become larger and more prominent on the posterior body segments. Most xystodesmids have transverse rows of microsetae; normally, however, these are set on extremely small tubercules that can be seen only when the tergum is dry and illuminated from a particular angle. The rows

of tubercules apparently tend to become most pronounced in the tribe Rhysodesmini. Several species of *Rhysodesmus* are tuberculate; one, *R. toltecus*, is characterized by several transverse rows of metatergal raised areas.

Sexual dimorphism.—In most xystodesmids the females tend to be slightly larger than males from the same locality. Usually the antennae are relatively smaller in females and the sterna relatively broader than in males of the same size. In some species, particularly in the Rhysodesmini, the size difference between the sexes becomes pronounced and the extreme condition occurs in *Boraria deturkiana* in which the female may attain nearly twice the bulk of the male. Presumably, pronounced sexual size dimorphism is accountable as an evolutionary specialization and, in this case, affords a useful criterion in judging affinities. Taking the case of *B. deturkiana*, the combination of coxal spination, strongly depressed paranota, and difference in size between male and female sets the species in apposition to *B. stricta* and *B. media* and perhaps warrants retention of the name *Howellaria* as a subgeneric designation.

Epicranial suture.—In all polydesmoids there is a distinct median suture on the vertex of the head capsule that is reflected internally as a median septum upon which the mandibular adductor muscles originate. In earlier literature the suture was referred to as the vertigial sulcus, but I think that it is essentially homologous to the epicranial suture of insects and should be so designated. In most species the suture becomes indistinct in the interantennal isthmus, but in a few it is ventrally bifid, and the two lateral branches extend nearly or quite to the antennal sockets. This is the case in *Boraria media* and *B. deturkiana*, and, along with the nearly identical gonopods, attests a close relationship between these two species. In *B. stricta*, at least in the adult condition, the two ventral branches are obscure or invisible although they are distinct in young or recently moulted specimens.

Probably only specific value can be assigned to the ventrally bifid condition since *B. media* and *B. stricta* are undoubtedly congeneric and quite similar in nearly all other characters. We could consider this feature, perhaps, a retention of a juvenile character, but, since it occurs so prominently in *B. deturkiana*, a species that obviously is specialized in other details, an equally good case could be made for interpreting the bifid epicranial suture as some kind of specialized development.

Gonopods.—I have remarked previously (1960) the tendency among rhysodesmines toward conservatism in gonopod form even though the

body structure may vary considerably among species. This condition is particularly true in *Rhysodesmus* itself, the species of which share an essentially identical gonopod pattern. In *Boraria* the telopodite is simple and distally laminate, with a slender, acicular prefemoral process. In *B. media* and *B. deturkiana* the gonopod is similar in most respects (cf. figs. 10, 18), distally the telopodite is accuminate. In *B. stricta* the corresponding region is hastate with a distal and two subterminal acute projections, but, with low magnification, the gonopods of all three species are nearly identical. The gonopod of *Gyalostethus monticolens* is somewhat different in structure. There is a much shorter prefemoral process, the glabrous part of the telopodite is much less laminate than in *B. stricta*, and the distal extremity is expanded and laciniate when examined with sufficient magnification. In this character alone *G. monticolens* is as different from the three species of *Boraria* as the latter are from Mexican *Rhysodesmus*. In association with the many other structural pecularities of *G. monticolens*, this difference leaves no doubt that the species is not congeneric with *B. stricta* and, in fact, is probably not even closely related to it.

Within the limits of the species here considered, the gonopods are virtually identical. The prefemoral process in *Gyalostethus monticolens* varies a little in length but only as sporadic individual variation. In *Boraria media* there is a slight variant in the shape of the telopodite just below the prefemoral process (cf. figs. 9, 10), and the two gonopod forms that are so characterized do occur in vicarious populations. Some authors would instantly accord specific status to these populations, but I think that, at the present, a conservative treatment is desirable (see the discussion under "Variation" in the account of *B. media*).

Cyphopods.—The transverse sympleurite of the third segment in female xystodesmids is modified rarely into any special kind of epigynal structure although there may be enlarged lateral lobes of the anterior edge as in *Pachydesmus* and some other genera. The sternum and legs of the second pair likewise tend to be quite uniform, but as a rule the cyphopods themselves may be different from one species to another and sometimes even differ among subspecies (cf. my *Pachydesmus* paper, 1958, figs. 5*a–f*). One highly variable cyphopodal element is the basal receptacle, which may be a semiglobose or semicircular shielding structure that extends on both sides of the valves. In others the receptacle is reduced to a flat, simple plate just large enough for muscle attachment; in a few, such as *Cherokia*, the receptacle is not present. In both of the genera treated here, it is reduced in size but not otherwise differing between the two groups. In *Boraria*

stricta the receptacle is set with a number of prominent macrosetae that are absent from the structure in *B. media* and *B. deturkiana*.

There is also some difference in shape of the valves. In some genera they are rather broad and prominently corrugate and enclose a flattened, transversely striate intervalvular area. In most of the Rhysodesmini the valves tend to be compressed and closely applied to each other; usually one is distinctly larger than the other. Internally the valves contain one or more seminal receptacles of variable size and shape. In *Boraria* there appear to be two such structures (fig. 5); in *Gyalostethus*, one only. So far, I have not studied the condition in other xystodesmid genera, but such a study should be made and probably would be entirely rewarding.

STIGMATA.—Insofar as I have been able to determine, the openings of the tracheal system in the Diplopoda have never been considered for their possible utility in classification. During the past few years, I have been noting the size, shape, and position of the stigmata and find they offer excellent generic and familial characters that correlate closely with those of the genitalia and other traditional diagnostic structures. In the Xystodesmidae the stigmata tend to be essentially similar among related genera, usually subequal in size, obverse pyriform in shape, and located just in front of (often upon) the dorsal coxal condyle. In some cases the stigmata may be located upon slight elevations or the dorsal edges may be slightly flared. In *Gyalostethus* the anterior stigmata are distinctly larger than the posterior, an unusual condition in the family and one which warrants special recognition.

Taking all of the preceding matters into account, I think the point is sufficiently made that *G. monticolens* is not congeneric with the three species *B. stricta, B. media*, and *B. deturkiana*. We may place it in a monotypic new genus, separable from *Boraria* by the characters cited in the preceding section and in the generic diagnoses that follow. Some of the more conspicuous characters may be cited in the following couplet:

1. Sterna of metazonites unmodified; sides of segments without a longitudinal ridge above coxal sockets; pretarsi about ⅓ as long as tarsi, not concealed by long tarsal setae; stigmata not strikingly unequal in size; posterior corners of paranota of only the caudalmost segments produced; distal end of gonotelopodite simple, laminate . . . . **Boraria**, p. 315

   Sterna of metazonites unusually broad and depressed, saucer-like; segments 3–15 with a distinct longitudinal ridge just above coxal sockets; pretarsi very short, largely concealed by long, slender distal tarsal setae (fig. 23); anterior stigmata about 3 times as large as posterior; caudolateral corners of paranota of segments 6–19 acutely produced; distal end of gonotelopodite expanded, cupulate, the edges finely laciniate . . . . **Gyalostethus**, p. 338

Genus *Boraria* Chamberlin

Aporiaria (part) Chamberlain, 1939, p. 6.
Boraria Chamberlin, 1943b, p. 143.—Chamberlin and Hoffman, 1958, p. 22.
Howellaria Hoffman, 1950, p. 26.—Chamberlin and Hoffman, 1958, p. 37. [New synonymy.]

Type species.—*Boraria: Aporiaria carolina* Chamberlin, 1939, by original designation; *Howellaria: Aporiaria deturkiana* Causey, 1942, by original designation.

Diagnosis.—A genus of small to moderate-sized xystodesmids with the following characteristics:

Body composed of head and 20 segments in both sexes; small to moderate in size, slender to moderately robust, the W/L ratio varying from 17 to 23% among the 3 species. Head of normal proportions, smooth, with the usual facial setae present; genae with median impression, or, in 1 species, the impression is continuous laterally to the margin; antennae long and slender, separated by a broad isthmus. Epicranial suture distinct; ventrally bifid in 2 species.

Body segments generally smooth and polished, metatergites with several transverse rows of small tubercules in 1 species, prozonites and metazonites of about the same diameter, meeting at a shallow interzonal stricture dorsally. Paranota subhorizontal to strongly depressed, the posterior corners rounded on anterior segments, becoming acutely produced only on the last 4 or 5 segments; scapulorae submarginal; pores large, dorsolateral, in large depressions on the broadened, flat peritremata; pore formula normal.

Posterior segments normal in form, segment 20 sometimes slightly telescoped but about average in size for xystodesmids; hypoproct large, smooth, with or without a prominent median projection.

Sterna broad, the legs widely separated; sternum of metazonites scarcely modified, only slightly elevated at bases of legs, no tendency for development of subcoxal spines or paramedian lobation; surface smooth and glabrous.

Legs moderately long and slender; coxae unspined except in 1 species where provided with prominent ventrally directed, acute distal spines; prefemora with small, short distal spines. Pretarsi of normal size and shape; slightly curved, compressed, without dorsal carinae, about ⅓ as long as tarsi. Sides of segments smooth and polished, unmodified. Anterior and posterior stigmata of about same size and shape, subovoid or pyriform, largest dorsally, not rimmed or auriculate.

Sterna and legs of anterior segments of males without special processes or other modifications except low paramedian knobs between

4th pair of legs. Gonopod aperture of moderate size (fig. 2), oval, the posterior edge with a flared rim.

Gonopods rather small in relation to body size, extending cephaled between 6th pair of legs only; coxae simple, without apophyses, connected by a small indistinct sternal remnant. Telopodites set against coxae at a right angle, nearly straight, the prefemoral region not greatly expanded, with a slender, elongate, prefemoral process which nearly attains apex of telopodite proper. Distal end of telopodite flattened, laminate, without branches or distinct lobes. Prefemur about 60–75% of total length of telopodite.

Cyphopods of the form shown in figures 5 and 11; the receptacle present but reduced in size; valves large, approximate in size, apparently 2 seminal receptacles are present. Both valves and operculum, and, in other species, also the receptacle, heavily setose. No special modifications of 2nd legs or epigynal region of 3rd segment.

SYNONYMY.—There is no longer justification for retention of the name *Howellaria.* This genus was set up at a time when, not knowing *B. media,* I was impressed by the numerous differences between *B. stricta* and *B. deturkiana.*

In most details of body form, *B. media* and *B. stricta* are similar, and contrast rather strongly with *B. deturkiana.* The last named form, however, shares with *B. media* the branched epicranial suture, and the same gonopod formation. The relationships are mentioned in greater detail under the discussion of *B. media.*

SPECIES OF UNCERTAIN STATUS.—One name, *Aporiaria brunnior* Chamberlin, 1943a, has been based upon a member of this genus, the status of which remains uncertain. I have been unable to restudy the holotype and have seen no material that agrees entirely with the original description. I therefore quote this in its entirety:

> This, the smallest of the known species of the genus, has the dorsum brown with keels and a transverse band over caudal border of metazonites yellow, thus contrasting with the other known species in which the dorsum is black. Antennae and legs light.
>
> Keels without anterolateral denticle, the margin being smooth throughout; posterior corners produced beginning with the 5th or 6th, the production becoming more pronounced in posterior segments as usual.
>
> All coxae without spines.
>
> Gonopods of male as shown in fig. 10.
>
> Length of male holotype, about 20 mm.; width, 4 mm.
>
> Locality.—Tennessee: Gt. Smoky Mts. Nat. Park. June 5, 1941. One male taken by J. Miller.

All of the information given, including the gonopod sketch, indicate that this name is based upon a milliped similar to, if not identical with, *Boraria media.* The smallest specimen of *B. media* that I

could measure precisely was about 24 mm. in length, but it is entirely possible that local populations may exist with even smaller individuals. The coloration of *B. brunnior* is not singular, for in the description of Chamberlin's previously named *Aporiaria geniculata* occurs the statement "Dorsum black *or nearly so* [italics mine], with the keels yellow, the tergites in part also narrowly margined with yellow across caudal border." In the specimens of *B. media* that I have seen, brownish coloration occurs sporadically, and occasional specimens, particularly recently moulted ones, tend to show transverse tergal stripes of yellowish.

My inclination is to regard the name *B. brunnior* as a junior synonym of *B. media*, but perhaps it is best to withhold final judgment until the holotype, or fresh topotypes, can be studied. Possibly *B. brunnior* can be retained as a subspecific designation.

Range.—Southern Appalachian region from Virginia to Georgia. Two of the species are confined to western North Carolina and extreme eastern Tennessee. The generic distribution coincides closely with the Southern Section of the Blue Ridge Physiographic Province.

Species.—Three are recognized as valid, along with a possible fourth, which was discussed in a preceeding paragraph. It seems unlikely that any undescribed species of *Boraria* remain to be found.

Key to the Species of *Boraria*

1. Epicranial suture poorly defined, not branched between the antennae; metatergites with several transverse rows of conspicuous tubercules; dorsum glossy black with bright lemon-yellow paranotal spots, sides of segments also black; distal end of gonopod subhastate in shape (fig. 3). **stricta** Brolemann

   Epicranial suture distinct, branched between the antennae (fig. 14); metatergites smooth and polished except for faint rugosity at bases of paranota; dorsum dark brown to blackish, sides of segments lighter, paranotal spots orange or red; distal end of gonopod slender, acuminate (fig. 8) 2

2. Coxae not spined; paranota set high on sides and not strongly depressed; dorsum blackish, with reddish paranotal spots; epicranial suture without a row of punctures . . . . **media** Chamberlin

   Coxae with prominent ventrally directed terminal spines (fig. 16); paranota strongly depressed, the dorsum thus appearing nearly terete; dorsum blackish, with paranotal spots and transverse tergal bars orange yellow; epicranial suture with a row of small punctures . . . **deturkiana** Causey

Boraria stricta **(Brolemann)**

Figures 1–7

Fontaria tennesseensis var. *stricta* Brolemann, 1896, p. 63, figs. 17, 18.
Fontaria stricta Brolemann, 1900, p. 101, fig. 31.
Rhysodesmus strictus Attems, 1938, p. 144, fig. 167.

Aporiaria carolina Chamberlin, 1939, p. 6, fig. 10 [new synonymy].
Aporiaria fumans Chamberlin, 1943a, p. 37, fig. 9 [new synonymy].
Borraria carolina Chamberlin, 1943b, p. 144.—Hoffman, 1949, p. 379; 1950, p. 23.—Chamberlin and Hoffman, 1958, p. 22.
Boraria stricta Chamberlin and Hoffman, 1958, p. 23.
Boraria fumans Chamberlin and Hoffman, 1958, p. 22.

Type specimens.—Cotypes of *Fontaria tennesseensis* var. *stricta*, Museum National d'Histoire Naturelle de Paris and USNM D-730; collected in "North Carolina" by Eugene Simon. Holotype and paratypes of *Aporiaria carolina*, RVC, from Soco Gap Falls, Jackson Co., N.C., collected April 29, 1939, by Nell B. Causey. Holotype of *Aporiaria fumans*, CNHM, from Greenbrier Cove, Great Smoky Mountains National Park, Sevier Co., Tenn., collected June 13–19, 1942, by Henry S. Dybas.

Diagnosis.—A species of *Boraria* characterized by the color pattern (dorsum black with lemon-yellow paranotal spots), by the unbranched epicranial suture; by the distinct transverse rows of metatergal tubercules; by the unspined coaxe; and by the hastately lobed apex of the gonopod telopodite.

Description.—Male from Mount Squires, Blount Co., Tenn. Total length ca. 33.0 mm., greatest width 5.5 mm., W/L ratio 16.7%. Body slender, parallel sided, the paranota set high on sides and nearly horizontal, the dorsum thus appearing distinctly flattened.

Head capsule, dorsum *and sides* of metatergites, distal half of antennae dark gray to black; labrum tan; paranotal spots and tip of epiproct bright yellow; sternites and bases of legs burnished brown; legs tinged with black.

Head of normal shape and proportions, the surface smooth and very finely punctate. Epicranial suture distinct, shallow, not branched in the interantennal isthmus; latter broad (1.1 mm.), about 16% of the antennal length. Genae nearly flat, with pronounced broad median depression. Antennal sockets not rimmed. Antennae long (6.9 mm.) and slender, 1st article large, globose, with 4 long macrosetae on the dorsal side, otherwise glabrous; 2nd article clavate, distinctly geniculate at base, distally exceeding genal apex; articles 3–6 subsimilar in size and shape, each cylindric, clavate, with sparse and scattered erect setae and a subterminal whorl of 3 or 4 macrosetae; 7th article small, subconic, distally truncate, densely setose, with sensory areas or fields; 4 small terminal sensory cones.

Collum large, convex, about as wide as head across mandibles and not as wide as 2nd segment, the entire front edge evenly curved, the rear edge distinctly emarginate across dorsum, laterally bent forward to the rounded ends of the collum. Surface smooth and polished;

cephalolateral marginal ridge distinct nearly to middle of collum, set off by a prominent, broad, submarginal depression.

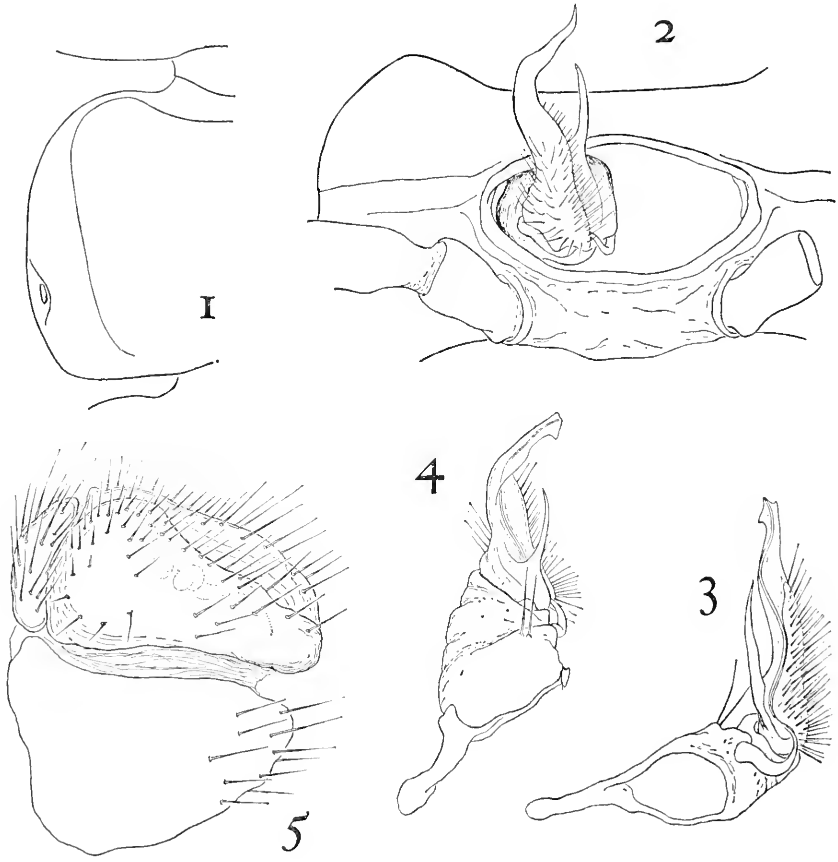
Body segments smooth, evenly convex and flat, the prozonites and metazonites approximately equal in length, and meeting dorsally at a fine sutural line, forming the anterior edge of the interzonal furrow; latter distinct and sharply defined across dorsum of anterior segments, becoming broader and less well defined on posterior segments. Metatergites of anterior segments smooth, those of midbody and posterior segments becoming increasingly tuberculate, those of segments 14–18 with about 3 to 5 transverse rows each of 16–18 small but distinct setiferous tubercules visible to the unaided eye. Paranota smaller than average for xystodesmids, set high on segments and only slightly depressed, thus scarcely interrupting slope of middorsum. Paranota of anteriormost segments bent forward, overlapping, with both lateral corners rounded, the anterior and lateral edges set off by a prominent submarginal depression. Paranota of midbody segments not overlapping, the caudal corners rectangular; those of segments 11–19 with the caudal corners caudally produced, the anterior corners rounded. Scapulorae entirely marginal; peritremata flat but prominent; ozopores rather large and located in conspicuous dorsolateral peritrematic depressions (fig. 1), posterior edge of all paranota essentially straight, without basal lobe. Paranota of segment 19 small, rounded lobes; epiproct small, partially retracted, dorsally convex, without special modification.

Paraprocts glabrous, smooth, nearly flat, with prominent elevated median edges, the ventral seta set on a tiny tubercule slightly removed from the rim, the dorsal seta set on an enlargement of the rim near its dorsal end. Hypoproct large, smooth, flat, semicircular in outline, without distinct median apical projection; paramedian tubercules small, removed from the edge; the setae very long.

Ventral surface of prozonites smooth and polished, set off from metazonites by a shallow, sinuous interzonal furrow. Legs set on subcoxal elevations which form a low but well-defined glabrous podosternum; no subcoxal spines developed. Sterna of midbody segments 1.2 mm. in width, the legs of both pairs about equally separated.

Legs relatively long and slender, the distalmost 4 podomeres visible beyond paranota when extended laterad; coxae much shorter than prefemora and without trace of distal spine, prefemoral spine very short and acute, both of these leg segments with 2 or 3 large ventral setae; femora longer, clavate; postfemora and tibiae short, as broad as long; tarsi longer, set with numerous erect setae; pretarsi

long, slender, and compressed, a 3rd as long as tarsi, not enclosed by the distal tarsal setae. Podomeres in decreasing order of length: 3>6>2>5=4=1.



FIGURES 1–5.—*Boraria stricta* (Brolemann): 1, left paranotum of 9th body segment, dorsal aspect × 45; 2, sternal aperture and right gonopod in situ, 7th segment, ventral aspect × 45; 3, left gonopod, mesial aspect × 45; 4, left gonopod, dorsal aspect × 45, showing small sternal remnant; 5, right cyphopod, caudal aspect × 100, showing seminal receptacles by dotted lines.

Interzonal furrow distinct down sides of segments, most sharply defined in front of anterior stigma; lateral surfaces finely wrinkled, otherwise unmodified. Stigmata similar in size and shape, both are asymmetrically pyriform, slightly elevated but without flared rims, both are in contact with the dorsal coxal condyle.

Anterior legs unmodified, without distinct processes. Sterna of

5th segment with 2 knobs between the 4th pair of legs, other sterna unmodified.

Gonopod aperture (fig. 2) moderate in size, transversely oval, posterior edge with an erect flared rim. Sternum between 8th pairs of legs depressed. Coxae of gonopods large, almost in contact medially, connected by a small elongate sternal remnant as shown in figure 4. Gonopods elongate, extending cephalad between legs of the 6th segment, the sternum of which is depressed to accommodate gonopodal apices. Coxae somewhat flattened dorsoventrally, the dorsal side without apophysis, with 2 macrosetae. Telopodite typically set at nearly a right angle to coxite, slender, without indication of segmentation. Prefemoral region setose, elongate, about 60% of the entire telopodite length, with a slender acicular prefemoral process. Distal 3rd of telopodite thin and hyaline, bent medially at about a 30° angle from the median axis of telopodite, the terminal, and tridentate, the distalmost lobe carrying the seminal groove (figs. 2, 3, 4).

Female (Mount Squires, Blount Co., Tenn.): Total length 37 mm., width 7.1 mm., W/L ratio 19.2%. Structurally similar to male with the following exceptions:

Body proportionately more robust, gradually increasing in width back to segment 15; paranota smaller than in male, the corners more rounded, posterior corners acutely produced only on segments 15–19. Dorsal tubercules much more prominent, easily visible without magnification. Interzonal groove more distinct, longitudinally vaguely costulate. Podosterna broader and not quite so elevated, legs set about 2.7 mm. apart on midbody segments. Color essentially as described for male.

Cyphopods of the form shown in figure 5.

Variation.—There appears to be no appreciable structural variation within the range of *Boraria stricta.* I have closely compared specimens from Georgia and Virginia with each other and with material from North Carolina and can find no departures aside from individual and sexual variation in size. Even this is highly sporadic in distribution, and I could locate no particular area where populations tended to be larger or smaller than the average for the species. As usual in the genus, females are distinctly larger than males and have a higher W/L ratio, as shown by the following table (averages in parentheses), which is based on 10 specimens of each sex selected at random:

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
males	10	26.0–30.5 (28.7)	4.5–5.3 (5.0)	16.7–18.5 (17.5)
females	10	30.0–37.0 (33.6)	5.4–7.0 (6.4)	18.0–19.9 (18.9)

Both the largest male and largest female are from one collection made on Mount Squires in the Great Smoky Mountains, N.C.: the male 33 mm. long, the female 37 mm. long. The smallest male (26 mm.) is from Soco Gap, less than 20 miles from Mount Squires; the smallest female (30 mm.), from the Chattooga River southeast of Highlands, N.C. Probably the cited extremes nearly approximate the variation to be expected within the species. Insofar as length is concerned, all but one of the males are less than 31 mm. and all but one of the females are more than 30 mm. in length.

Synonymy.—Insofar as I can determine, *Boraria stricta* is a homogeneous and essentially unvariable species over its entire distribution. Both of the junior synonyms *Aporaria carolina* and *A. fumans* were proposed without cognizance of Brolemann's name; *A. fumans* was said to differ from *A. carolina* because of a small difference in the edge of the telopodite blade. This ostensible distinction does not exist. The illustration of the gonopod of *A. fumans* is accurate, but that of *A. carolina* appears somewhat stylized and cannot be matched exactly by any of the dozen male topotypes which I have seen.

Biological notes.—The paucity of published records for *Boraria stricta* is certainly curious in view of the fact that, in my own experience, this species is one of the most abundant and easily collected xystodesmids of the Southern Appalachians. Perhaps it has escaped the notice of general collectors because of its predilection for unusually moist environments. The following excerpts from field notes made on the scene will give a good impression of the habitat preference:

Asheville, N.C.: " . . . in black wet mud under flat rocks."

Grimshawes, N.C.: " . . . four under debris on the sandy bank of the Chattoga River."

Rabun Co., Ga.: "1 female *stricta* under a rock by a rushing stream."

Johnson Co., Tenn.: "Male in black mud by stream."

Soco Falls, N.C.: " . . . in wet , muddy seepage, on a steep hillside."

Jonas Ridge, N.C. "1 male *stricta* by stream in sand mud, under wet leaves."

Bat Cave, N.C.: "*B. stricta* in a muddy spring seepage."

Altapass, N.C.: "Numerous specimens of *stricta* under leaves and debris along a small stream, virtually in the water."

All of the material which I have collected originated from localities less than 100 feet from streams or spring areas. The species is more nearly semiaquatic than any other milliped I know, with the possible exception of *Oxidus gracilis*. In places where the mud is fairly firm, *B. stricta* occurs in burrows apparently of its own making, both in the adult and late nymphal stages.

Despite the abundance of the species, I have found mated pairs only once, at Indian Gap, Sevier Co., Tenn., on Aug. 3, 1958.

So far the egg chambers have not been discovered. On one occasion I found the moulting chambers of *B. stricta* and made the following notes:

> Sept. 4, 1961. Asheville, N.C. Collected on Beaucatcher Mountain for several hours; conditions very dry; . . . located a small trickle down through the dry woods, here found *B. stricta* under rocks in wet places. Several adult females, and immatures in two different stages, either in or constructing "igloos." These are oblate spheroid, with a "chimney" and attached at the base, usually found in animal burrows in the wet black mud under flat rocks. . . . The large ones (made by the penultimate instars?) are about the diameter of my thumbnail = ca. 15 mm.

The typical appearance is about as shown in the accompanying figure. The chambers being constructed were in the early stages, less than half completed, the milliped working from the inside and apparently using both mouthparts and paraprocts alternately. The occupant must come and go until the last stages, and then complete the roof and chimney with the paraprocts, as the chimney could scarcely be formed by the mouthparts from the inside.

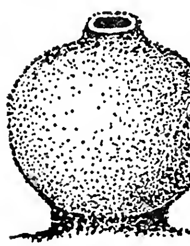


FIGURE 6.—*Boraria stricta* (Brolemann): moulting chamber constructed by last nymphal instar, sketched from life, actual diameter about 15 mm.

DISTRIBUTION.—The known range of this species coincides closely with the Southern Section of the Blue Ridge Physiographic Province as defined by Fenneman (1938) and as shown by the dotted line in figure 7. Within this area, *B. stricta* is abundant and easily collected in moist or wet habitats. The altitudinal range extends from around 1000 feet in western South Carolina up to 5200 feet or more in the Iron, Black, and Great Smoky Mountains. Probably the existing records depict the actual distribution closely although I would anticipate some slight range extensions at both the northern and southern extremities.

Specimens (personally collected, and in my collection unless otherwise indicated), have been examined from the following localities:

Virginia: Franklin Co.: headwaters of Shooting Creek, ca. 4 miles SW. of Endicott, 1♂, 1♀, May 28, 1957. Grayson Co.:

Mount Rogers, 5000′, 2♂, July 1, 1947; Helton Creek at U.S. Highway 58, ca. 4000′, 2♂, 3♀, June 19, 1950, J. A. Fowler and R. L. Hoffman. Patrick Co.: Pinnacles of Dan, 4 miles SW. of Vesta, 1♂, 2♀, May 30, 1951, W. B. Newman and R. L. Hoffman.

Tennessee: Blount Co.: Mount Squires, 4500–4800′, E. of Cades Cove, 1♂, 3♀, July 7, 1955, R. Highton and A. VanPelt. Greene Co.: Tusculum College near Greeneville, 1♂, Apr. 18, 1947, M. Wright. Johnson Co.: along Beaverdam Creek, 5 miles NE. of Shady Valley, 1♂, July 11, 1962. Sevier Co.: west side of Indian Gap, 5000′, Great Smoky Mountains National Park, 7♀, 2♂, Aug. 4, 1958.

North Carolina: Ashe Co.: Mill Hill, near Jefferson, 3♂, 6♀, July 1922, C. M. Breder (AMNH). Avery Co.: between Banner Elk and Newland, 3♂, June 14, 1954. Buncombe Co.: Asheville, 2♀, 2 imm., Sept. 4, 1961; Black Mountain, 1♀, June 16, 1935, W. J. Gertsch (AMNH). Buncombe-Transylvania Cos.: Pisgah Mountain campground, 5♂, June 15, 1953, Hubricht. Burke Co.: 4 miles SE. of Jonas Ridge on N.C. Highway 181, 1♂, July 13, 1962. Graham Co.: Stratton Gap, 4300′, Unicoi Mountains, 4♂, May 27, 1958, Hubricht. Haywood Co.: Wagon Road Gap, 4 miles S. of Cruso on U.S. Highway 176, 1♂, 1♀, June 5, 1952. Haywood-Transylvania Cos.: Pisgah Ridge, 2♀, July 17, 1955, A. VanPelt. Henderson Co.: 1 mile SW. of Bat Cave on U.S. Highway 64, 2 imm., July 13, 1962. Jackson Co.: Chattooga River near Grimshawes, 2♂, 2♀, July 24, 1949; Soco Gap Falls, 12 miles E. of Cherokee on U.S. Highway 19, 4♂, 3♀, July 28, 1949; also 8♂, 2♀, May 20, 1956, W. T. Keeton, W. C. Lund, and R. L. Hoffman. Macon Co.: Cowee Bald, N. of Franklin, 1♀, July 21, 1952, Thelma Howell; also 2♂, July 18, 1958. Cullowhee Gap road, north of Cullasaja, 2♂, July 10, 1958; Highlands, 4000′, 1♂, July 13, 1949; 1♀, July 25, 1949; 3.5 miles N. of Highlands, 1♂, Aug. 3, 1958; Otter Creek, west side of Wesser Bald, 2♀, July 29, 1949, F. Bryson and R. L. Hoffman; Shuler's Ruby Mine, ca. 5 miles N. of Franklin on Cowee Creek, 3♂, 2♀, July 22, 1961. Mitchell Co.: Altapass, 6♂, 6♀, May 20, 1956, Keeton, Lund, Hoffman. Swain Co.: near Blowing Spring, 3 miles NE. of Nantahala, 2♂, May 6, 1951, Hubricht; base of Cliff Ridge at Nantahala, 3♂, 7♀, May 6, 1951, Hubricht. Transylvania Co.: along U.S. Highway 176 just below Looking Glass Falls, 2♂, 2♀, June 5, 1952. Watauga Co.: Boone, 1♀, Aug. 11, 1948, M. Wright. Yancey Co.: Blue Ridge Parkway below the Pinnacles, 2♂, 2♀, June 28, 1951, Hubricht; summit of Mount Mitchell, 6600′,

3♂, 6♀, June 26, 1950, Hubricht; Spivey Gap, U.S. Highway 19E about 1 mile E. of the Tennessee state line, 1♀, June 2, 1952.

South Carolina: Oconee Co.: Chattooga Ridge, 2 miles N. of Mountain Rest, 1♀, July 21, 1958.

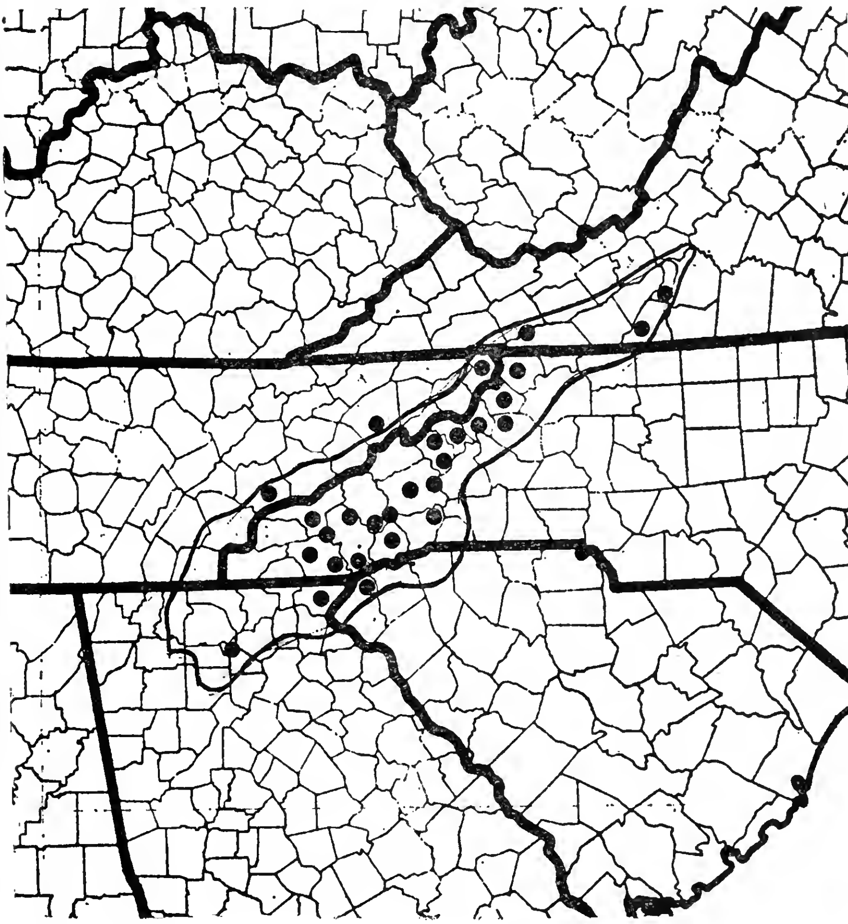


FIGURE 7.—Distribution records for *Boraria stricta* (Brolemann). Each dot is a collecting locality except for closely approximate sites where one dot may cover several places. Enclosing line shows limits of Southern Section of Blue Ridge Physiographic Province (Fenneman, 1938) to which *B. stricta* appears to be endemic.

Georgia: Dawson Co.: Amicalola Falls State Park, 1♂, Nov. 6, 1960, Hubricht. Rabun Co.: Clayton, 1♂, July 1910, W. T. Davis (AMNH); Glade Mountain, E. of Satolah, 1♀, July 27, 1949; Burrell's Ford road, E. of Pine Mountain, 1♀, Sept. 6, 1961.

Boraria media (Chamberlin)

FIGURES 8–12

Nannaria media Chamberlin, 1918, p. 125.—Attems, 1938, p. 199.
Aporiaria geniculata Chamberlin, 1939, p. 6, fig. 10; 1940, p. 56 [new synonymy].
Boraria media Wray, 1950, p. 44.—Chamberlin and Hoffman, 1958, p. 22.
Boraria geniculata Chamberlin and Hoffman, 1958, p. 22.

TYPE SPECIMENS.—Holotype and paratypes of *Nannaria media* (MCZ), from Burbank, Carter Co., Tenn., collected by Roland Thaxter. Holotype and paratype of *Boraria geniculata* (RVC), from Soco Falls, Jackson Co., N.C., collected Apr. 29, 1939, by Nell B. Causey.

DIAGNOSIS.—Dorsum brownish black, paranota with reddish or chestnut spots; epicranial suture distinct and ventrally branched in the interantennal isthmus; metatergites without rows of small tubercules; some, however, tend to be finely rugulose laterally; coxae unspined; legs longer than in *B. stricta*, tibiae twice as long as broad.

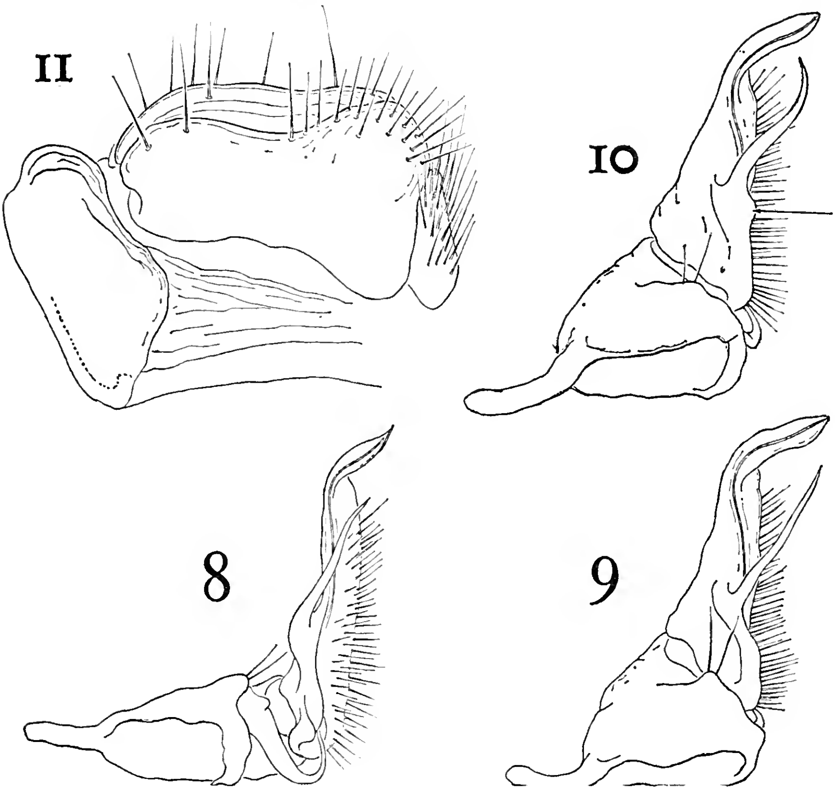
DESCRIPTION.—Male topotype, 2 miles S. of Burbank, Tenn. Body length 24 mm., greatest width 4.9 mm., W/L ratio 20.4%. Dorsum nearly black, the paranotal spots reddish chestnut; underparts nearly white, distal 2 segments of legs becoming yellowish.

Head of normal proportions in relation to body size, the surface smooth and polished. Epicranial suture distinct, not punctate, branched in the interantennal isthmus, the lateral arms extending to the antennal sockets. Genae flat with prominent median impression, not margined laterally. Facial setae: 2–2 supra-antennal; 1–1 frontal; 1–1 clypeal; 4–4 genal. Interantennal isthmus broad (1.0 mm.), about 19% of the antennal length. Antennal long (5.3 mm.) and slender, 1st article large, globose, with 4 long macrosetae on the dorsal side, otherwise glabrous; 2nd article elongage, clavate, slightly geniculate basally, distally exceeding genal apex; articles 3–6 similar in size and shape, cylindric, slightly clavate, with sparse scattered erect setae and a subterminal whorl of 3 or 4 macrosetae; 7th article small, subconic, truncate, densely setose, without sensory areas; 4 small terminal sensory cones.

Collum large, convex, about as wide as head across mandibles, not as wide as following tergite; entire front edge evenly curved, the rear edge nearly straight across dorsum and not emarginate, laterally curved forward toward the rounded lateral ends. Surface smooth and polished, cephalolateral submarginal ridge distinct nearly up to median area.

Body segments smooth, evenly convex, nearly flat, the 2 subsegments of approximately equal length and diameter, meeting dorsally

at a fine sutural line, interzonal furrow distinct across dorsum, narrowly and sharply defined on anterior segments but becoming broader, less well defined, and distinctly punctate on posterior segments. Metatergites smooth and polished, with only irregularly scattered, very small tubercules, dorsum of segments 17–19 becoming longitudinally wrinkled laterally. Paranota smaller than average for the



FIGURES 8–11.—*Boraria media* (Chamberlin): 8, left gonopod, mesial aspect × 45, topotype from Burbank, Tenn.; 9, left gonopod, same as fig. 8, dorsal aspect × 45 (type 1 gonopod, distribution shown in fig. 12); 10, left gonopod, dorsal aspect × 45, specimen from southeastern Buncombe Co., N.C. (type 2 gonopod, arrow indicates marginal indentation at base of prefemoral process, occurrence shown in fig. 12); 11, left cyphopod, caudal aspect × 100.

family, depressed from the horizontal but slightly interrupting the dorsal convexity, those of midbody segments not overlapping. Paranota of anteriormost segments sloped forward, overlapping, with both outer corners rounded, the anterior and lateral edges set off by a prominent submarginal depression. Paranota of segments 14–19

with posterior corners caudally produced, anterior corners rounded, scapulorae entirely marginal, peritremata flat but prominent, the pores rather large and located in deep pits. Posterior edge of all paranota essentially straight, without basal lobes. Paranota of segment 19 small, broadly rounded lobes; epiproct small, partially retracted into preceeding segment, of the usual subtriangular profile.

Paraprocts glabrous, smooth, nearly flat, with prominent elevated median edges, the ventral seta set on a tiny tubercule slightly removed from the rim, the dorsal seta set on an enlargement of the rim near its dorsal end. Hypoproct large, smooth, strongly flattened, depressed toward lateral ends, semicircular in outline with a distinct median apical projection; paramedian setiferous tubercules small, removed from the edge, the setae very long.

Ventral surface of prozonites smooth, separated from metazonites only by a fine, indistinct groove. Legs set on prominent subcoxal elevations, but no distinct elevated podosternum formed; caudal margin of sternum broadened medially, with a small but distinct raised rim. All sternal areas smooth and glabrous, no subcoxal spines formed. Sterna of midbody segments about 1.5 mm. wide, legs of both pairs equally separated. Coxae much shorter than prefemora and without trace of distal spine; prefemoral spine very short and acute, both coxa and prefemur with 2 or 3 ventral macrosetae; femora elongate, clavate, postfemora distinctly longer than broad, tibiae twice as long as broad; tarsi longer, set with numerous erect setae increasing in length toward end of segment; pretarsi long, slender, and compressed, ⅓ as long as tarsi. Legs relatively long, the distalmost 4 podomeres visible beyond paranota when extended laterad. Length relationships of podomeres: $3>6>2>5>4>1$.

Interzonal furrow distinct down sides of segments, best defined in front of anterior stigma; lateral surfaces of segments smooth, unmodified. Stigmata similar in shape, the anterior stigma somewhat larger than posterior, slightly elevated but without flared rims, both stigmata in contact with the dorsal coxal condyle.

Anterior legs unmodified. Sterna of segment 5 with 2 low paramedian knobs between the 4th pair of legs, other sterna not modified.

Gonopod aperture moderate in size, transversely oval, posterior edge with very low marginal rim. Sternal surface between 8th pair of legs depressed only at center. Gonopods relatively large, of the form as shown in figures 8 and 9.

Female (from Roan Mountain, Tenn.): Body length ca. 28 mm., greatest width 6.3 mm., W/L ratio 22.5%. Similar to male in most details of body structure and color pattern. Body proportionately

broader, and increasing in width back to about 14th segment; tergites distinctly more convex than in the male; paranota smaller than in male, the posterior corners produced only on segments 17–19. Antennae proportionately longer and more slender than in males, 6.0 mm. in length. Legs widely separated, the intercrural distance at midbody about 1.9 mm.; podosterna very low and with a deep, prominent transverse groove separating anterior and posterior leg pairs. Interzonal furrow distinct but shallow with a single row of punctations. Spines of prefemora longer than in males, and slightly curved upward.

Cyphopods of the form shown in figure 11; the receptable smaller than in *Boraria stricta* and lacking macrosetae.

VARIATION.—*Boraria media* differs from its two congeners in showing considerable geographic variation in at least 2 characters. Aside from the usual amount of individual and sexual variation in size and proportions (summarized below), there is an appreciable difference in body form which is related to geography, and two, largely vicarious, variant forms in the gonopod structure. There is at present not sufficient material at hand to permit a good analysis of these phenomena, but some preliminary inferences can be drawn and commended to the attention of some future worker. Unfortunately, few of the female specimens are in satisfactory condition for accurate length measurements, so that the following remarks have to be based largely upon members of the male sex.

As usual in this genus, females tend to be distinctly larger and more robust than males. This is suggested by the following summary of measurements (averages in parentheses):

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
males	10	24.0–33.0 (29.3)	4.9–6.7 (6.0)	19.1–22.9 (20.4)
females	5	–	6.3–7.1 (6.8)	–

Geographic variation in body proportions: On the basis of male specimens only, it can be shown that variation in the body form can be related in a general way to the species' horizontal distribution. The narrowest specimen measured has a W/L ratio of 18.1%; the broadest, 22.9%. Individual ratio figures, when plotted on a map, tend to sort out with the highest percentages near the center of the range, the lowest figures at peripheral points (fig. 12). Elsewhere in the Xystodesmidae, there seems to be a tendency for broader body form to be associated with more specialized genera and species, and so perhaps we have here a case of centripetal widening of the body. But the available data must be supplemented by far more evidence, particularly from peripheral populations.

Gonopod form: There are two distinct variants in gonopod form

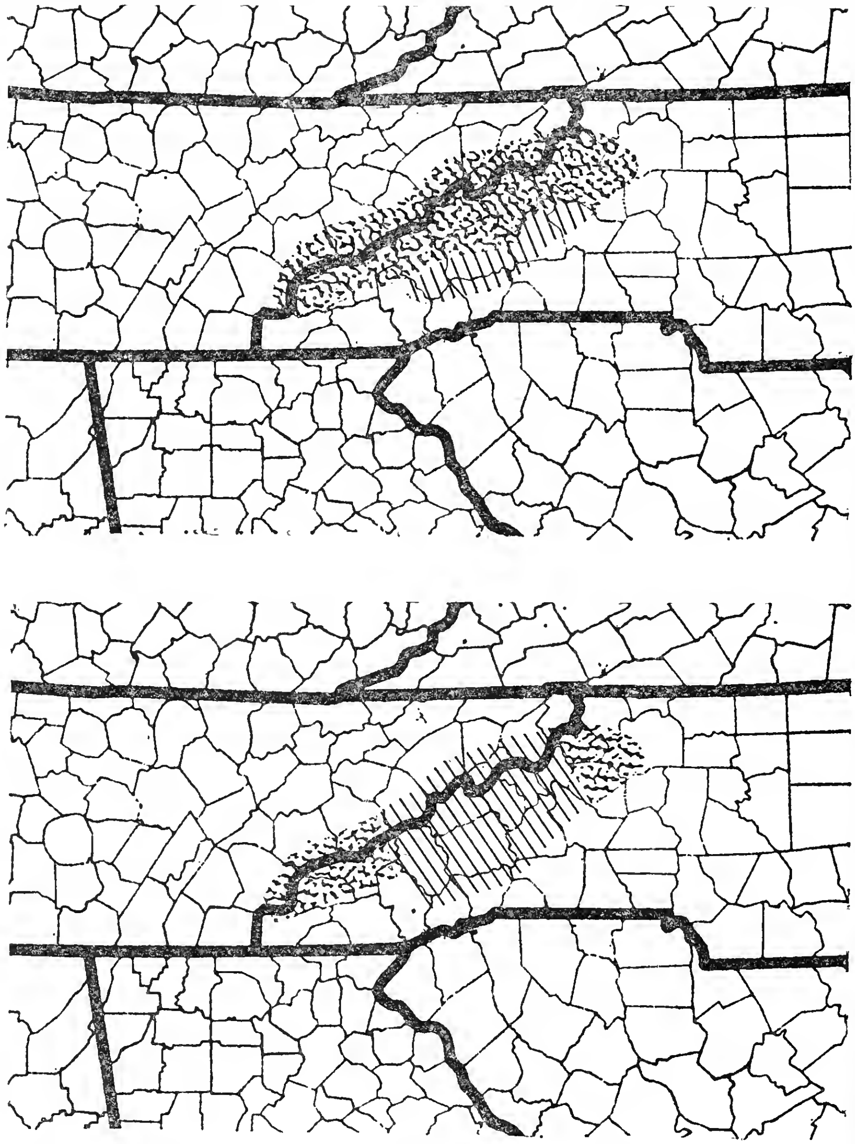


FIGURE 12.—Geographic variation in two characters in *Boraria media*. Upper map: distribution of gonopod types 1 (heavy stippling) and 2 (oblique shading). Lower map: distribution of broad vs. narrow body form in males, populations in which W/L ratio is less than 20.0% (heavy stippling) vs. populations in which this ratio is greater than 20.0% (shading).

within the species *Boraria media*. In one phase, the medial edge of the telopodite (as seen in dorsal aspect) is convex at the base of the prefemoral process, as indicated by the arrow in figure 10. In the other phase, this same edge is distinctly concave in profile, as shown in figure 9. These differences do not show up when the gonopod is viewed in mesial aspect. The two gonopod types essentially are geographically vicarious, type 1 being peripheral, type 2 central (fig. 12). In a general way, there is some coincidence in the distribution of gonopod types and body form. But as the maps show, there is not a very close concordance in the northern part of the range. At one locality (Mount Mitchell), both gonopod types occur. There seems to be some sort of differentiation going on within this species, but I do not think that we are justified for the present at least in recognizing even subspecies of *B. media*. If a distinction were to be made on gonopod form alone, type 1 would represent the nominate form, type 2 would carry the name *B. geniculata*. But the magnitude of the difference is certainly of a low order and hardly sufficient for the basis of subspecific names.

Color pattern variations: The normal coloration in this species is that described in a preceeding paragraph: the dorsum dark brown to blackish, with reddish or pink paranotal spots. Occasionally the dorsum is lighter brown, with the spots more orange; in a few specimens, chiefly those which recently have moulted, there is a tendency for the metatergites to have a light transverse caudal stripe. Such specimens are sporadic and have been seen at various parts of the range (Roan Mountain, Grandfather Mountain, Soco Gap) and have no systematic or nomenclatorial significance.

Synonymy.—*Nannaria media* was described without illustrations of the gonopods and fell into complete obscurity. In 1949 I examined the types at Harvard and discovered that the species is not congeneric with *Nannaria minor*, described in the same paper, but that it is congeneric with *Boraria stricta*. Subsequently, through the kind cooperation of Dr. Chamberlin, I examined the male type of *B. geniculata* and found it to agree in all essential respects with that of *B. media*.

Biological notes.—Specimens of *B. media* have been collected from April to September, but this period obviously represents the active season of collectors rather than the milliped. I have collected *B. media* at about six localities and am unable to make any generalization about habitat preferences. On Roan Mountain, specimens were abundant under stones near the edge of grassy fields; elsewhere I have found the species under logs in oak woods, in the leaf litter in laurel

thickets, in hemlock-rhododendron stands, and on wet exposed rock cliffs. None have yet been found in copulation, and I know nothing of the immature stages. *B. media* certainly cannot be collected as easily as its congener *B. stricta* although it is often locally abundant and occurs over nearly as great a geographic area.

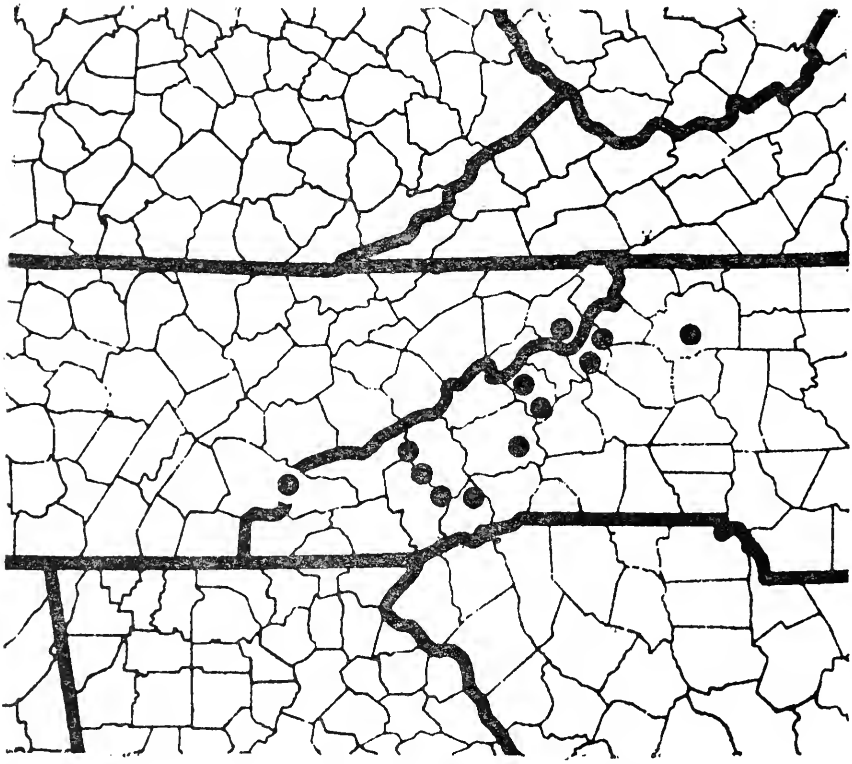


FIGURE 13.—Distribution records for *Boraria media* (Chamberlin). Except in two cases, each dot is a separate collection; near Grandfather Mountain, N.C., several adjacent sites are covered by a single dot.

DISTRIBUTION.—The mountains of western North Carolina and adjacent east Tennessee (fig. 13). Almost certainly the species occurs in north Georgia and southwest Virginia and is to be expected in these areas. All but one of the known localities are in the higher mountain region, at elevations ranging from 3000 to 6600 feet. The exceptional locality—in Wilkes County, North Carolina—is considerably lower and somewhat to the east of the Blue Ridge, but the specimens from there are entirely typical and similar to those from the center of the range.

Specimens have been examined from the following localities:

North Carolina: Avery Co.: east side of Grandfather Mountain on U.S. Highway 220, about 2 miles NE. of Linville, 1♀, June 1, 1954; between Banner Elk and Newland, 1♂, June 15, 1953; near Linville Falls, 1♀, Aug. 3, 1949. Buncombe Co.: between Bat Cave and Black Mountain, on N.C. Highway 9, 1♂, July 5, 1955. Haywood Co.: Beech Gap, S. of Sunburst, 1♂, June 14, 1953, Leslie Hubricht. Jackson Co.: below Jones' Knob, 5000′, Plott Balsam Mountains, 1♂, May 26, 1958, Hubricht. Transylvania Co.: 1.5 miles N. of Looking Glass Rock, U.S. Highway 276, 1♂, May 26, 1958, Hubricht. Wilkes Co.: Pores Knob, Brushy Mountains S. of Moravian Falls, 1♂, April 5, 1952, Hubricht. Yancey Co.: Spivey Gap, U.S. Highway 19W, 1 mile E. of the Tennessee state line, 1♂, June 2, 1952; top of Mount Mitchell, 6600′, 2♂, Sept. 9, 1950, B. D. Burks (USNM).

Tennessee: Carter Co.: Burbank, ca. 2 miles S. of Roan Mountain Station, ♂ holotype, Roland Thaxter (MCZ); S. of Burbank, at 4000′, 8♂, 9♀, May 2, 1951, Hubricht (USNM); Roan High Bluff on Roan Mountain, 5♂, 4♀, June 20, 1950, J. A. Fowler and R. L. Hoffman. Monroe Co.: Little Haw Knob, 5000′, Unicoi Mountains, 2♂, May 27, 1958, Hubricht (locality astride the state line and could also be cited in Graham Co., N.C.).

Boraria deturkiana (Causey)

Figures 14–19

Aporiaria deturkiana Causey, 1942, p. 169, fig. 8.
Howellaria deturkiana Hoffman, 1950, p. 26, figs. 7, 8, 13.—Chamberlin and Hoffman, 1958, p. 37.

Type specimen.—Male holotype, ANSP, from Highlands, Macon Co., N.C., collected June 14, 1940, by William DeTurk.

Diagnosis.—A species of *Boraria* characterized by the strongly depressed paranota, punctate epicranial suture, prominent coxal spines, and acuminate apex of the gonopod telopodite.

Description.—Male topotype, Highlands, N.C. A slender, smooth, strongly convex species, the paranota depressed and continuing slope of dorsum; body essentially parallel sided from segments 6 through 16. Color in life dark greenish black dorsally, paranotal spots and a narrow transverse stripe on the caudal border of each metatergite yellowish orange; prozonites, antennae, mandibles, legs, and tip of epiproct yellowish white. Total length 28.5 mm., width 5.6 mm., W/L ratio 19.7%. Segment 13 height 3.9 mm., width 5.6 mm., H/W ratio 69.6%.

Head proportionately rather small, about 3.5 mm. across genae; the surface convex, smooth, polished; a deep rounded depression between the antennae; epicranial suture distinct, with a single row of small punctations, conspicuously branched between the antennae (fig. 14). Genae equally divided into: (1) a broad, flat, lateral margin; (2) a prominent subantennal swelling that does not extend to genal apex. Facial setae: supra-antennal 2–2, frontal 1–1, subantennal 1–1, clypeal about 13–13, labral about 14–14, genal 3–3. Interantennal isthmus wide (1.1 mm.), about 22% of antennal length.

Antennae of moderate length (5.0 mm.) and slender, extending caudad to 4th segment. 1st article globose with 5 macrosetae; 2nd article not distinctly geniculate basally, short, not extending beyond cranial margin; articles 2–6 essentially similar in size and shape, the distalmost articles densely setose; article 7 small, subconical, with 4 small sensory cones.

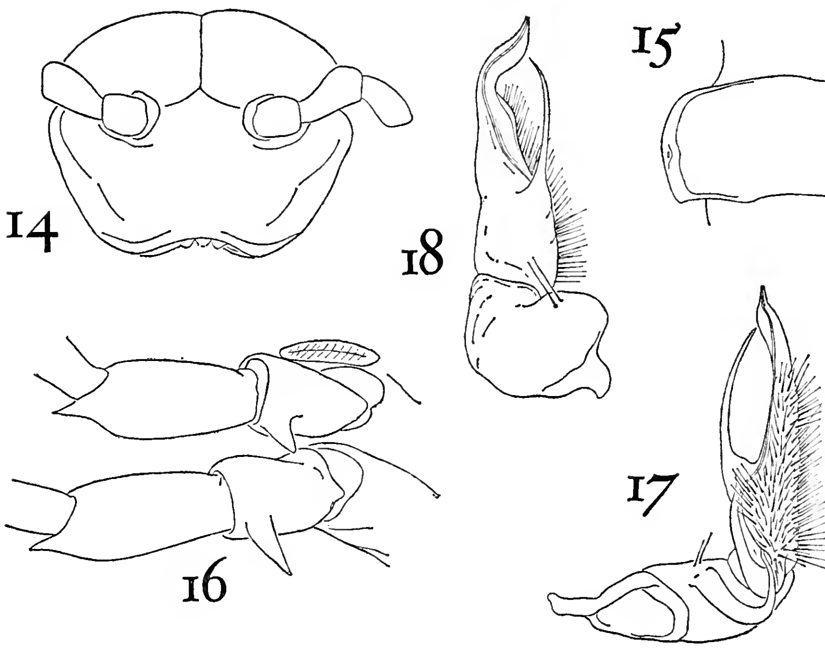
Collum small, ends broadly rounded and much shorter than ends of 2nd segment. Surface smooth and polished, marginal ridge extends along caudal edge nearly to mid-dorsum. Tergites of body segments smooth and polished, paranota strongly depressed ventrally, continuing slope of dorsum. Both subsegments about equal in diameter, metazonite distinctly the longer, the two separated dorsally by a sharply defined stricture. Paranota of segments 17–19 less depressed, nearly horizontal, their surface coriaceus.

Paranota small (fig. 15), widely separated from each other except on the anteriormost segments, anterior corners rounded back to about segment 12, thence becoming distinctly angular; posterior corners rounded on segments 2–4, thereafter becoming increasingly acutely angular. Anterior, lateral, and posterior paranotal edges margined on all segments. Scapulorae submarginal; ozopores large, opening laterally about at midlength of the elongate peritremata. Paranota of posterior segments join sides of the body cylinder at a re-entrant angle.

Epiproct small, triangular in outline, the lateral tubercules inconspicuous. Paraprocts prominently wrinkled, basal seta set on a nearly centrally located elevation of the discal surface, dorsal seta located at the broadest point of the smooth, thickened margins. Hypoproct flat, smooth, broadly triangular, with a prominent median projection.

Legs of midbody segments widely separated (1.5 mm.), the anterior legs of each segment slightly farther apart than the posterior. Legs attached to prominent subcoxal elevations which, on the caudal half of the body, become transversely connected to form moderately

distinct podosterna; all sternal areas smooth, glabrous, without trace of subcoxal spines. Legs long and slender, the distalmost 3 podomeres visible beyond sides of body when extended laterad. Coxae large, with prominent ventrally curved, terminal spines (fig. 16); prefemora twice as long as wide, with small, acute terminal spines; femora long, slender, clavate. Tarsi cylindrical, considerably longer than postfemora and tibiae combined, densely setose on the dorsal surface; pretarsi long, slender, distally curved, more than ⅓ as long as tarsi. Length relationship of podomeres: 3>6>2>1>5>4.



Figures 14–18.—*Boraria deturkiana* (Causey): 14, front of head and basal antennomeres, to show branching of epicranial suture; 15, left paranotum of 9th segment, dorsal aspect × 15; 16, coxae and prefemora of legs of a midbody segment, ventral aspect × 45, to show coxal spines; 17, left gonopod, specimen from Highlands, N.C., mesial aspect × 45; 18, same gonopod, dorsal aspect × 45.

Sides of metazonites finely wrinkled and punctate, the stricture very broad and deep down the sides, nearly obliterated near mid-ventral line. Caudal edge of sides with a fine, elevated rim. Stigmata similar in shape and position, with small marginal rims, both stigmata are turned conspicuously caudad and lying upon the upper coxal condyle.

Anterior legs unmodified, the first two pairs reduced in size; coxae

of 2nd legs with elongate, conical processes. Sterna of anterior segments narrow, without lobes or processes. Gonopod aperture small, narrowly ellipsoid, the posterior edge elevated into a high, sharp rim. Stigmata of segment 7 large and oval, located in a prominent deep depression in front of the coxae.

Gonopods relatively small, the coxae small and depressed, with 2 setae on the dorsal side. Solenite large, heavy at the base. Telopodite set on coxa at a right angle, the prefemur long (about 70% of the telopodite length) and setose, with a long, slender, acicular prefemoral process. Distal end of telopodite thin, flat, spatulate, terminally acute, the entire gonopod similar to that of *Boraria media.*

Female (Highlands, N.C.): Total length 37.5 mm., width 7.2 mm., W/L ratio 19.2%. Structurally similar to male with the following exceptions:

Body proportions about the same, but dorsum appearing more vaulted owing to the much smaller and more depressed paranota, the outer surface of which is nearly vertical on midbody segments. Antennae short (5.7 mm.) and slender, reaching back only to middle of paranota of 3rd segment. Sterna proportionately broader than in male (1.5 mm. at midbody), coxal and prefemoral spines larger and more acute; legs smaller and more slender than in male. 3rd segment not modified ventrally, the sympleurites forming a narrow, simple, transverse strip behind the 2nd pair of legs. Cyphopods very similar to those of *Boraria media.*

Variation.—Within the small range of this species there is little in the nature of geographic variation. There is, however, pronounced individual and sexual variability in size, as indicated by the following table (averages in parentheses):

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
males	6	21–30 (26)	4.1–5.8 (5.1)	19.0–20.0 (19.4)
females	8	31–37 (35)	5.5–7.3 (6.6)	18.0–19.5 (18.8)

In the 14 specimens measured, there was no overlap at all between the total lengths for males and females, the average length being 10 mm. greater in females. There was virtually no overlap in width values for the two sexes; here the females averaged 1.5 mm. wider than males. There can be no doubt that sexual dimorphism in overall size is far greater than in the other species of *Boraria,* and, in fact, than in any other xystodesmid known to me.

The females tend to be about the same size in both of the two areas where this species has been found (the Great Smoky Mountains and the vicinity of Highlands, N.C.: 2 specimens from Highlands average 6.9 mm. in width, 6 from the Smokies average 6.6 mm.); however, there is apparently a striking divergence between males from these

two localities. Three males from Highlands average 5.6 mm. wide, whereas 3 from the Smokies average only 4.6 mm. in width, a difference of a full millimeter. Of course, the series examined are far too small to show the full range of variation in the two regions, yet they unquestionably indicate that a size differential does exist. It is the more remarkable that only the male sex seems to be involved.

In all other respects (structural details, color pattern, gonopods), all of the specimens appear to be quite uniform and invariable.

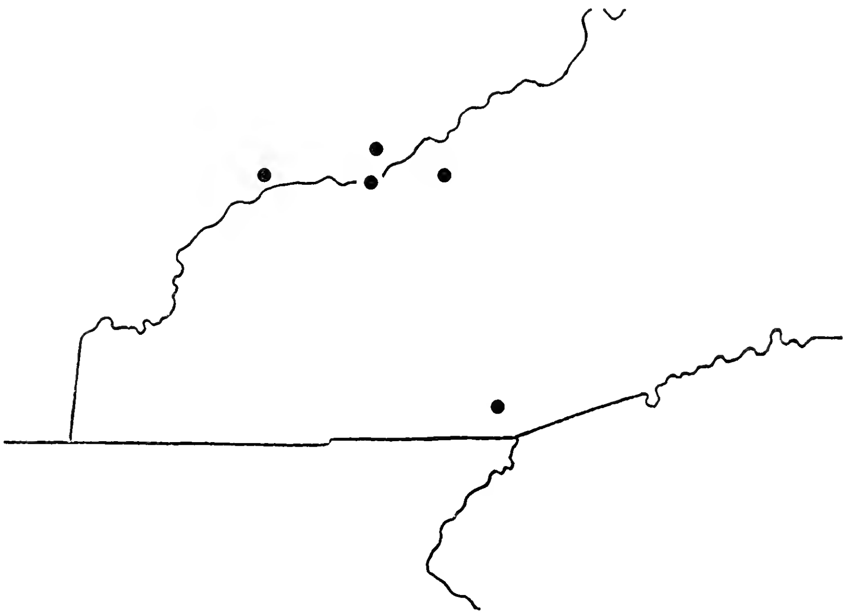


Figure 19.—Distribution records for *Boraria deturkiana* (Causey). Each dot is a separate locality.

Biological notes.—Virtually nothing is known of the biology of this species. The available material was all collected during June and July, but the period of activity is undoubtedly much longer. All of the specimens from Highlands, N.C., were found in the rhododendron thicket surrounding Lake Ravenel at the Biological Station; those from Heintooga Ridge were also from rhododendron litter. The specimen from Chimneys Camp Ground in the Smokies came from mixed hardwood and hemlock cove forest; those from Clingman's Dome presumably are from the evergreen forest which covers the upper thousand feet of that mountain.

Boraria deturkiana seems clearly to be a high-altitude species; the known localities range between about 3000 and 6600 feet.

763-237—65——3

Distribution.—The higher mountain areas of western North Carolina and eastern Tennessee. Specimens have been examined from the following localities:

North Carolina: Haywood County: Heintooga Ridge, near Black Camp Gap, 2♂, 1♀, June 18, 1953, T. Howell, M. J. Westfall, R. L. Hoffman. Macon County: Highlands, 1♂, July 13, 1949; 1♂, June 23, 1950, L. Hubricht; 2♀, June 2, 1954.

Tennessee: Blount County: Mount Squires, on state line above Cades Cove, 4♀, July 7, 1955, R. Highton and A. VanPelt. Sevier County: Chimneys Camp Ground, Great Smoky Mountains National Park, 1♂, July 29, 1949; Clingman's Dome, 4♂, 2♀, June 14, 1954, H. E. and M. A. Evans; between Gatlinburg and Newfound Gap, 2♀, June 1960, J. G. Barker.

These localities fall into two distinct areas: one centered in the Great Smoky Mountains, the other at Highlands, N.C., about 35 miles to the southeast. Almost certainly *B. deturkiana* occurs in the intervening area, but so far it has not been found despite repeated collecting in the Balsam and Cowee ranges. There appears to be no evident difference between specimens from the two regions.

Gyalostethus, new genus

Type species.—*Boraria monticolens* Chamberlin, 1951.

Diagnosis.—A genus of small rhysodesmine xystodesmids characterized by the following structural details:

Body composed of head and 20 segments in both sexes; small, robust, sexually dimorphic: W/L ratio about 22% in males, 23% in females. Head proportionately large, smooth, with only clypeal and labral setae; genae not impressed medially; antennae long and slender, separated by a broad interantennal isthmus.

Body segments smooth, polished, prozonites and metazonites forming a perfectly flat surface dorsally, meeting at a suture line only, no interzonal furrow. Paranota depressed, the posterior corners produced from segment 6 to segment 19, the posterior edges deeply concave; scapulorae entirely marginal; pores small, dorsolateral, in elongate peritremata, the pore formula normal.

Posterior segments of the usual form, segment 20 somewhat smaller proportionately than usual for xystodesmids, hypoproct large, flat, semicircular, without median apical projection.

Legs widely separated, the anterior pair of each segment set farther apart and higher up on sides than posterior pair, sternum of metazonite

deeply depressed and excavated, with an elevated thin posterior rim between the coxae of the posterior legs; sterna smooth and glabrous, no subcoxal spines formed.

Legs fairly long, 3 distal podomeres visible beyond edges of paranota when extended laterad; coxae unspined, prefemora with small, short distal spines (fig. 22); pretarsi very small, evenly curved, largely concealed by the long, slender, terminal tarsal setae. Sides of segments smooth and polished except for a horizontal ridge just above coxae of posterior pair of legs on segments 3–15 or 16, the ridge largest (and tuberculate) on anterior segments, becoming smaller caudally. Anterior stigma about 3 times as large as posterior, subcrescentic in shape, neither stigma with elevated rims or otherwise modified.

Legs and sterna of anterior segments without special processes or other modifications. Gonopod aperture small, oval, the posterior edge elevated into a distinct smooth flange.

Gonopods large, extending cephalad between legs of 5th segment; of the form shown in figure 24; coxae simple, without ventral apophyses, telopodite attached at a right angle, slender, the prefemoral region not much enlarged, with a short, acicular prefemoral process; telopodite beyond prefemur, a narrow, nearly straight, subterminally bigeniculate blade, the end expanded and lamellate, finely laciniate; no separate solenomerite developed. Prefemur about 50% of the total length of telopodite.

Cyphopods of the form shown in figure 25; the receptacle present but greatly reduced in size to a simple rolled plate for muscle attachment; valves approximately subequal, but inner valve smaller toward its distal end; a large simple rounded seminal receptacle present. Both valves and operculum densely set with long slender macrosetae. No special modifications of 2nd legs or epigynal region of 3rd segment.

Range.—Southern Appalachian region from Virginia to Georgia and Alabama (fig. 26).

Species.—One. *Gyalostethus monticolens* is a not uncommon endemic form of the southeastern United States.

The name *Gyalostethus* derives from the Greek *gyalos* (concave) plus *stethos* (chest).

Cyalostethus monticolens (Chamberlin), new combination

Figures 20–26

Boraria monticolens Chamberlin, 1951, p. 26, fig. 16.—Chamberlin and Hoffman, 1958, p. 23.

Type specimen.—Male holotype (RVC) from the Great Smoky Mountains National Park, Sevier Co., Tenn., collected by H. Hanson [date and exact locality unknown].

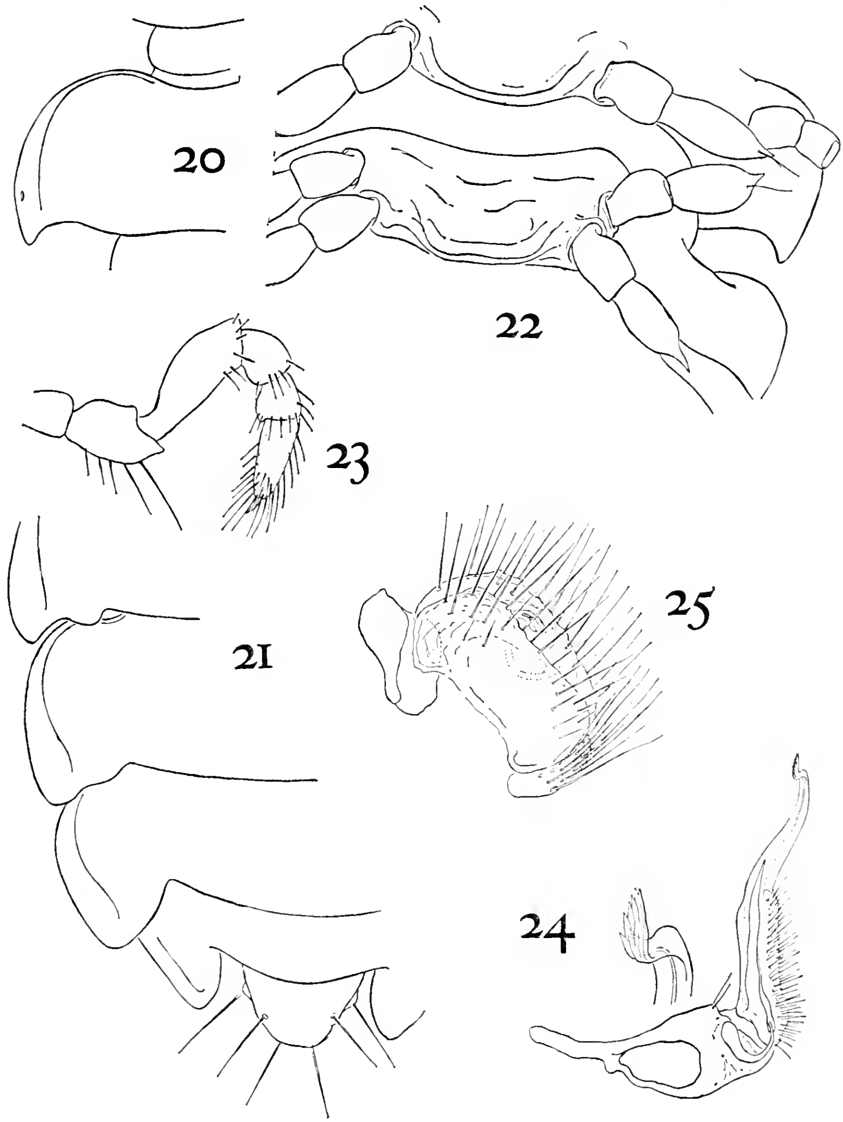
Diagnosis.—With the characteristics of the genus.

Description.—Male, Sequatchie Co., Tenn. Body length 16.8 mm., greatest width 3.8 mm. Dorsum uniformly light testaceous brown; antennae, prozonites, and sides below paranota almost colorless.

Head rather proportionately large, smooth, polished, evenly convex; epicranial suture distinct but not impressed or punctate; interantennal isthmus broad (ca. 0.56 mm.), exceeding length of 2nd antennal article. Genae moderately convex, not margined, without median groove. Antennal socket not rimmed. Antennae long (ca. 3.0 mm.) and slender, 1st article large, globose, with 2 long macrosetae on the dorsal side, each ca. 0.45 mm. in length, otherwise glabrous; 2nd article clavate, distinctly geniculate at base, distally exceeding genal apex; articles 3–6 subsimilar in size and shape, each cylindric, clavate, with sparse and scattered erect setae and a subterminal whorl of 3 or 4 macrosetae; 7th article small, subconic, truncate, densely setose, without sensory fields or areas; 4 small terminal sensory cones.

Collum large, convex, broader than head across mandibles and exceeding ends of 2nd segment, ca. 2.8 mm. wide and 0.95 mm. long; the entire front edge evenly curved, the rear edge nearly straight and distinctly emarginate across dorsum, thence bent forward to the rounded lateral ends of the collum. Surface smooth and polished; cephalolateral submarginal groove distinct only near ends.

Body segments smooth, evenly convex, and flat, the prozonites and metazonites approximately equal in length and meeting dorsally at a fine sutural line, no interzonal furrow present, and both subsegments of exactly the same diameter. Paranota moderately large, depressed, but slightly interrupting the dorsal convexity, those of midbody segments not overlapping. Anteriormost paranota sloped forward, overlapping, with both corners rounded, the anterior and lateral edges set off by a prominent submarginal depression. Paranota of segments 6–19 with posterior corners acutely produced, the anterior corners rounded, scapulorae entirely marginal, peritremata flat but prominent, pores small, dorsolaterally located, not in depressions. Posterior edge of paranota concave, with a rounded lobe at the base, this lobe becomes increasingly prominent on segments 15–16, thence much smaller on segment 17, and absent from segment 18 (fig. 21). Paranota of segment 19 small subtriangular lobes; epiproct small, partially retracted, broadly rounded.



FIGURES 20–25.—*Gyalostethus monticolens* (Bollman): 20, left paranotum of 9th segment, dorsal aspect × 45; 21, left side of posterior end of body, dorsal aspect × 45, showing basal lobation of caudal edge of paranota of segments 16 and 17; 22, sterna and bases of legs of two midbody segments, ventral aspects × 45; 23, leg from midbody segment × 45, showing very small pretarsus and proportions of podomeres; 24, left gonopod of male, medial aspect × 100, also distal end of telopodite × 430 to show details of structure; 25, cyphopod, caudal aspect × 100.

Paraprocts glabrous, smooth, nearly flat, with prominent elevated median edges, the ventral seta set on a tiny tubercule slightly removed from the rim, the dorsal seta set on an enlargement of the rim near its dorsal end. Hypoproct large, smooth, flat, semicircular in profile, no median apical projection; paramedian tubercules small, removed from the edge, the setae very long (ca. 0.40 mm.).

Ventral surface of prozonites smooth and polished, set off from metazonites by a shallow, sinuous interzonal furrow. Legs set on small subcoxal elevations, but entire sternal area between legs deeply depressed, a thin elevated rim extending between the posterior legs of each segment, bounding a concave, saucer-like area (fig. 22), the surface of this depression different in texture from prozonite, frequently rugulose punctate. All sternal areas smooth and glabrous, no subcoxal spines developed. Sterna of midbody segments ca. 1.0 mm. wide, anterior legs of each segment distinctly wider apart than the posterior, and set higher up on side of segment. Coxae and prefemora short, subequal in length and shape except prefemora with short acute spine, both sparsely setose; femora longer, clavate; postfemora and tibiae short, as broad as long, tarsi longer, set with numerous erect setae increasing in length toward the end, pretarsi very small and short, concealed within the terminal tarsal setae. Legs relatively long, the distalmost 3 podomeres visible beyond paranota when extended laterad.

Interzonal furrow distinct down sides of segments, best defined in front of anterior stigma; lateral surfaces smooth and polished except for a short horizontal ridge above the posterior coxae, this ridge most prominent, and distinctly tuberculate, on anterior segments but extending back about to midbody. Stigmata very different in size and shape, the anterior stigma larger, crescent shaped, posterior much smaller, straight, elongate oval, less than ½ as long and wide as anterior; both stigmata lack elevated rims, both are distinctly separated from dorsal coxal condyles.

Anterior sterna and legs unmodified, without processes. Sternum segment 6 with a subcoxal elevation at base of posterior leg pair, the space between depressed for tips of gonopods.

Gonopod aperture small, regularly oval, the posterior rim elevated around to the lateral ends of the aperture. Gonopods relatively large, extending cephaled between legs of 5th segment, of the form shown in figure 24.

Female (Jackson Co., Ala.): Length of body 22 mm., width ca. 4.8 mm., body widest near segments 15–16. In details of body structure agreeing closely with foregoing description of male, except for the

usual sexual differences of wider sterna, more highly arched tergites, slightly shorter antennae. Third segment without special epigynal modifications. Bases of 2nd pair of legs and cyphopods as shown in figure 25; receptable small, valves flat, ovate, similar in size, the outer valve with evenly curved profile, the inner constricted at midlength, both are densely set with long setae. A single, rounded, median seminal receptacle.

VARIATION.—There is no geographic variation in structural characters. Individually there is considerable range in size, and females tend to be considerably larger than males. The largest specimen measured is a female from Jackson Co., Ala., ca. 22.0 mm. long and 4.8 mm. wide, the next largest female is 21.4 by 4.9 mm. The smallest measureable female (Blacksburg, Va.) is 16.8 mm. long and 3.9 mm. wide. The largest male (Morgan Co., Ala.) measures 17.5 by 3.9 mm., the smallest (Giles Co., Va.) is 14.0 by 3.1 mm. A badly fragmented male from Newport, Tenn., appears to be even smaller but cannot be measured precisely. I believe that these figures give *G. monticolens* the distinction of being the smallest known species of the family Xystodesmidae.

Female specimens are not only larger in size, but also are distinctly broader in proportion to width. The following chart shows values for length, width, and ratio of width divided by length (averages in parentheses):

sex	*number*	*length (mm.)*	*width (mm.)*	*W/L ratio (%)*
male	5	14.0–17.5 (16.2)	3.1–3.9 (3.6)	21.5–22.6 (22.1)
female	4	16.8–22.0 (20.1)	3.9–5.0 (4.6)	22.8–23.2 (23.0)

SYNONYMY.—The original description of this species (Chamberlin, 1951) is extremely brief and consists of a color description and comparison of the gonopods with those of *B. brunnior* and *B. geniculata*. The right gonopod is illustrated in situ, with a fairly adequate drawing, although the characteristic appearance of the apex does not show up with the magnification used.

The legend for figure 16 contains the spelling "*Borarja monticolene,*" presumably an uncorrected typographical error.

It is indeed curious that an eastern milliped with so extensive a geographic range should not have been described until 1951. I had received two specimens from eastern Tennessee as early as 1948 but until recently lacked the opportunity to study them closely.

BIOLOGICAL NOTES.—There seems to be no definite limitation regarding preferred habitat. I have found the species at 5 localities, 3 of them in fairly dry limestone areas, one in shale terrain, the other in moist mesic woods underlain by metamorphics although no bedrock

was near the surface. A field note with one collection reads: "under rock at edge of creek."

Apparently *G. monticolens* is active throughout the year under clement weather conditions. The 15 collections at hand are distributed through the following months: February, March, July, September, and November, 1 each; April, 4; and May, 6. Curiously, I have not collected immature specimens referable to this species. Presumably there is a summer-long mating season, but I have found mated pairs only in September.

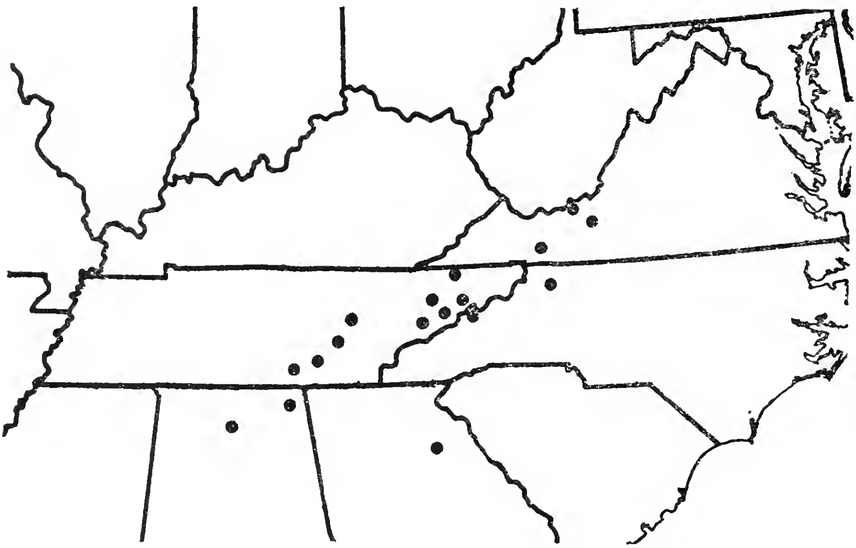


FIGURE 26.—Distribution records for *Gyalostethus monticolens* (Bollman): Each dot is a separate locality.

DISTRIBUTION.—In and adjacent to the Southern Section of the Blue Ridge Physiographic Province. The known range extends from southwestern Virginia south to north Georgia and west to north-central Alabama. There are as yet no records for South Carolina, Kentucky, and West Virginia, although the species surely occurs in all these states. Altitudinally, *G. monticolens* ranges from about 600 feet in the Georgia Piedmont to 5000 feet at Mount Rogers, Va.

Specimens have been examined from the following localities:

Alabama: Jackson County: 1.5 miles NE. of Hodge, May 21, 1961, 1♂, L. Hubricht. Morgan County: base of Doss Mountain, 1.7 miles SE. of Florette, Feb. 28, 1961, 1♂, Hubricht.

Georgia: Clarke County: wooded hillside, 9 miles W. of Athens, May 6, 1961, 1♀, Hubricht.

North Carolina: Madison County: wooded ravine along U.S. Highway 70, west side of Walnut Gap, July 22, 1961, 1♂, Hoffman, Wilkes County: Brushy Mountains, 1 mile S. of Oakwood, April 5, 1952 3♀, Hubricht.

Tennessee: Cocke County: English Creek at Carson's Spring, near Newport, April 17, 1946, 1♂, M. Wright. Greene County: Tusculum College, near Greeneville, March 12, 1946, 1♂, Wright. Hawkins County: 4.3 miles NE. of Surgoinsville, May 19, 1956, 1♂, Hoffman, Keeton, and Lund. Jefferson County: Strawberry Plains, 1887, 2♀, J. C. Branner [USNM]. Marion County: mountainside just W. of Ketner Gap, May 22, 1961, 1♂, Hubricht. Roane County: Clinch River bluff at Harriman, May 21, 1961, 1♂, Hubricht. Sequatchie County: 5.4 miles S. of Dunlap, April 3, 1960, 1♂, Hubricht.

Virginia: Giles County: sinkhole along U.S. Highway 460, 2 miles W. of Newport, Nov. 2, 1953, 1♂, Hubricht and Hoffman. Grayson County: east side of Mount Rogers, ca. 5000′, May 10, 1957, 1♂, R. Highton and Hoffman. Montgomery County: 5 miles NE. of Blacksburg, Sept. 17, 1957, 1♂, 1♀, Hoffman; Prices Fork, April 1962, 1♂, Hoffman.

The species has also been recorded, under the name *Boraria monticolens*, from Gatlinburg, Sevier Co., Tenn. (Chamberlin, 1951).

Relationships

The relationships of the two genera treated in this paper cannot be established with any degree of precision at the present. *Boraria* seems without doubt to have a close relative in the Mexican genus *Acentronus*—of which, unfortunately, I have not seen representatives—and doubtless also with the large genus *Rhysodesmus*. I think that in the past there must have been a continuous distribution between tropical Mexico and the southern Appalachians linking the three genera mentioned. There is, in fact, a remnant of such a continuum still extant in the Ozark region, a rhysodesmine species named *Cibularia profuga*.

Other genera of the Rhysodesmini represented in the eastern United States (such as *Cherokia*, *Pleuroloma*, and *Erdelyia*) are quite distinct among themselves and have little relationships to the *Boraria-Acentronus-Rhysodesmus* complex.

Gyalostethus is unquestionably a specialized genus endemic to the eastern United States. In most characters it seems more similar to the species of *Cruzodesmus* and *Cibularia* than to *Boraria* and, as previously observed, probably has little close affinity to *Boraria*.

The three species of *Boraria* are superficially similar in gonopod structure but differ trenchantly among themselves in other ways and can be identified readily in the female sex and even in late instar nymphs. Since all three are sympatric, probably the external characters have been emphasized to minimize the chances of hybridization. A distinct sequence in level of specialization can be observed: *B. stricta* departs less from the typical characters of the tribe in general, it has fewest specialized structures of the three, and sexual dimorphism is least pronounced. *B. deturkiana* is clearly a specialized form in nearly all of its features and, if *B. media* did not exist, would require a separate generic standing. But *B. media* forms the connecting link and is appropriately named even though it was originally proposed in a different genus as the second (hence intermediate) of three new species.

Interestingly enough, the structural relationships of these three species is paralleled inversely by their distributions. *B. stricta*, the least specialized, has the greatest range and is relatively abundant. *B. media* is more restricted and not so easy to find. *B. deturkiana* is known only from a limited area and is confined to elevations above 3000 feet. Most of its characters suggest that *B. deturkiana* is a localized derivative of *B. media.*

What is needed now are data of a comparative nature on the life histories and behavior of these three species.

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REVISION OF DIAPERINI OF AMERICA NORTH OF MEXICO WITH NOTES ON EXTRALIMITAL SPECIES (COLEOPTERA: TENEBRIONIDAE)

By Charles A. Triplehorn [1]

Introduction

In the family Tenebrionidae, the darkling beetles, is a group of genera which centers around the enormous and cosmopolitan genus *Platydema*. This group has been recognized as a natural one for a long period (see history of the group below), and has been referred to variously as a family, a subfamily, and a tribe. For reasons which will become evident later, I propose to regard it as a tribe, Diaperini, in the subfamily Tenebrioninae.

Various elements have been shuttled in and out of the Diaperini by different authors and a number of classifications have been proposed. Numerous attempts have been made in the past to define the limits of the tribe, but most of these were based solely on the fauna of a particular region and, when expanded to embrace the world fauna, were found to be quite deficient. As usual, the earlier works were based for the most part on the European fauna. Fortunately the Nearctic fauna is comparable to that of the Palaearctic region, so that both fit the system reasonably well.

[1] Department of Zoology and Entomology, Ohio State University, Columbus, Ohio.

In beginning a study of the North American Tenebrionidae, one's initial impression of the Diaperini is that it forms a taxonomically sound group. This was my own feeling on the matter when I reviewed the Ohio species of the family (Triplehorn, 1952). Later, as I began to extend my studies to include the western and southern elements, I soon realized that the group actually was poorly understood. Several extraneous components were present, tribal limits were ill-defined, a number of names of uncertain validity were scattered through the literature, several new species needed to be described, and a certain amount of synonymy was involved among existing species. Moreover, it was evident that despite Champion's excellent work on the Central American fauna, the Nearctic and Neotropical components of the tribe had been compared by him only superficially.

Thus, the problem, which resulted in this report, was suggested. It was decided to review critically the limits of the group on a worldwide basis, to attempt to establish its taxonomic position, and to revise the North American Diaperini in light of our present knowledge of the world fauna.

A number of impediments are immediately apparent. Most of the types of the North American species are in European museums and are inaccessible if, indeed, they still exist. Representative collections from all faunal areas would be impossible to assemble, study, and compare in the time allocated. Certain areas of the world, notably South America, are so rich in new species that too much time would be expended simply in describing the new species encountered.

The scope of the problem has therefore been modified to a revision of the North American components of the tribe, supplemented by remarks on the Neotropical and Palaearctic species that were available. Virtually no material was seen from other extralimital areas, but the taxonomic treatments of such areas as Australia, West Africa, and the Indo-Malayan region were consulted for information regarding the higher categories.

History of the group.—Prior to 1800, a number of authors had described species now included in the Diaperini. One needs only to study the synonymy involved in a well-known species, such as the European *Diaperis boleti* (Linnaeus), to appreciate how confusing these insects were to the early taxonomists. This species was originally described in 1758 as *Chrysomela Boleti* Linnaeus. Earlier it had been mentioned as a *Dermestes* without a specific name (Uddmann, 1753). In succeeding years it was placed in *Tenebrio* (DeGeer, 1775) and *Coccinella* (*fasciata*) Scopoli (1763).[2]

[2] Synonymy based on Seidlitz (1894, p. 515).

It remained for Müller (1776, p. 74) to validate the generic name *Diaperis* of Geoffroy by including under it *boleti* Linnaeus. The history of the group might perhaps be regarded as beginning at this point.

Other species have had a similar history. Among the North American species, *Neomida bicornis* (Fabricius) was originally described (1776) in the genus *Hispa; Platydema ellipticum* (Fabricius) was placed originally in the genus *Tenebrio* and later transferred to *Mycetophagus* (Fabricius, 1801). *Platydema flavipes* (Fabricius, 1801) was also placed in *Mycetophagus*.

By 1831, the genus *Diaperis* had become quite sizable. It was in that year that Laporte and Brullé produced their monumental taxonomic treatise on the world Diaperini entitled "Monographie du Genre Diaperis." In this key work, the authors divided the genus *Diaperis* in its older sense into seven component genera, recognizing and describing as new, *Platydema* and *Oplocephala* (=*Hoplocephala*=*Neomida*), both of which are represented in North America, and *Ceropria* of the old world tropics, along with *Diaperis* in its present sense. Three other genera which they originally included have been moved to other widely separated tribes.

Redtenbacher (1845, p. 128) was the first to assign a name to this assemblage of genera recognized by Laporte and Brullé. His "Familie Diaperides" contained five genera: *Pentaphyllus*, *Phyletes* (=*Alphitophagus*), *Platydema*, *Diaperis*, and *Oplocephala* (=*Neomida*).

The next important contribution was that of Mulsant (1854). He divided the European Latigènes (=Tenebrionidae) into five "Groupes" which more or less correspond to currently recognized subfamilies. His third "Groupe" he called "Les Diaperides," and this was divided into seven "Familles," among which are a number of units which we now recognize as tribes (e.g., Phaleriens, Ulomiens). Mulsant's third "Famille" was called "Les Diaperiens" and is roughly comparable to the tribe Diaperini in its present sense. On the basis of the entire anterior margin of the eyes, he separated the "Pentaphyllaires," containing only the genus *Pentaphyllus* from the remainder of the "Famille," which he called "Les Diapéraires." In this "Deuxième Branche" he recognized the following genera: *Scaphidema*, *Philethus* (=*Alphitophagus*), *Diaperis*, *Platydema*, and *Oplocephala* (=*Neomida*). It is to the everlasting credit of Mulsant that his concept of the group, proposed at this early date, still stands relatively unchanged. His six genera (including *Pentaphyllus*) are identical, except for nomenclatorial changes, with the six listed by Portevin in 1934 for France.

Redtenbacher (1858) divided the Tenebrionidae, as currently understood, into four families of which number 47 is the "Diaperides." In this family he placed 14 genera, including all of the genera

which comprise the Diaperini in its present sense, plus such extraneous elements as *Cossyphus, Oochrotus, Ammobius, Bolitophagus, Erelus, Trachyscelis, Sphindus,* and, interestingly enough, *Phaleria.* The genera now included in the Ulomini were placed in another family ("Tenebrionides").

Lacordaire (1859), treating the group on a worldwide basis, divided the "Ténébrionides" into 46 tribes of which number 29 is called "Diapérides." He followed Mulsant closely, retaining the distinction between the "Pentaphyllides" (genus *Pentaphyllus*) and the "Diapérides vraies," which included all the genera Mulsant recognized plus several tropical genera which need not concern us here (*Cosmonota, Ceropria, Hemicera*). This work contains no great innovation over that of Mulsant.

Jacquelin du Val (1861) divided the "Famille des Ténébrionides" into 23 "Groupes." His "Groupe 18, Diapérites" embraced the "Bolitophagites, Ulomites, Gnathocérites and Hypophloeites" or, in other words, the Ulomini and Bolitophagini of modern workers, as well as "Diapérites propres."

In the diaperines at least, he seems to have been a lumper of higher categories but a splitter at the generic level. His lack of conservatism influenced later workers to include a number of extraneous elements which ultimately made the Diaperini a catch-all for a number of genera which were difficult to place.

By the time of Reitter (1911*a*), the group was again on a relatively firm taxonomic foundation. He divided the Tenebrionidae into 12 tribes, the Diaperini containing *Scaphidema, Diaperis, Platydema, Arrhenoplita* (=*Neomida*), *Alphitophagus,* and *Pentaphyllus.*

Around the middle of the 19th century, as the earlier North American coleopterists began to give serious attention to the Tenebrionidae, they needed only to fit their new finds into an already well-constructed classification. No sweeping changes have been introduced by any of the American workers who confined their activities in the group to descriptions of new genera and species. The tribe Diaperini as treated by LeConte and Horn (1883) consisted of eight genera divided into three groups. The first group (Diaperes) contained *Diaperis, Hoplocephala* (=*Neomida*), *Platydema, Phylethus* (=*Alphitophagus*), *Liodema,* and *Scaphidema;* the second group (Hypophloei) contained *Hypophloeus;* the third group (Pentaphylli) contained *Pentaphyllus.*

As is frequently the case, the greater number of North American species of Diaperini were described by European workers. Prominent among these were Laporte and Brullé (1831). Through correspondence with A. Villiers of the Musée National d'Histoire Naturelle, it was learned that the specimens upon which their monograph was

based have passed through several hands and those that have not been totally destroyed are in such a state of disarrangement that they are unrecognizable. The descriptions of Laporte and Brullé are accurate and very clear, so that recognition of their species is for the most part relatively easy.

Motschoulsky (1873) proposed a number of names for North American species of Diaperini which until now have either gone unrecognized or have been misapplied. It is doubtful that he ever consulted any existing works (e.g., Horn's revision, 1870) since he described everything he encountered as new. Fortunately, he was a keen observer and a very fine writer, so that all of his species are recognizable and all but one of his North American species may be irrefutably placed as synonyms under older names.

In direct contrast stand the taxonomic endeavors of Chevrolat (1877a, b, 1878). Happily for this study, he encountered very few of the North American species, but the multitude of names which he has proposed for South and Central American species, all accompanied by unnecessarily brief and inadequate descriptions, has made it virtually impossible for anyone to work intelligently with species from these regions. Some of his descriptions could apply to any number of species. Also, he chose to publish in the Petites Nouvelles Entomologiques, a relatively obscure and not generally available journal. Finally, he presented neither keys nor synopses of his species, merely registering a short description of species after species with practically nothing of a comparative nature mentioned.

Morphology and terminology.—Each genus and species is fully described in what is hoped to be clear and understandable terms. In many instances, great emphasis is placed upon characters which, in the final analysis, are relative in nature. Such characters are, in themselves, highly objectionable but unavoidable in many cases. Quite often these descriptions presuppose a familiarity with some closely related species. This was done intentionally in order that the reader will have some point of reference. Where practicable, illustrations have been prepared to eliminate some of the guesswork, particularly in regard to characters used in the keys.

The only new character which has been utilized to any appreciable extent is the structure of the male genitalia. The terminology is essentially that of Sharp and Muir (1912), Blaisdell (1909, 1939), and Lindroth and Palmén (1956), all of whom more or less agree. It is not the purpose of this paper to delve deeply into the controversies attending such studies but to use these structures as taxonomic implements. For this purpose, the male aedeagi were useful in the broader classification aspects, but were seldom necessary in distinguishing between species.

The male aedeagus consists of a basal sclerite, a pair of parameres (the lateral lobes of Blaisdell), which are often fused to form a single piece, and a penis (the median lobe of Blaisdell) bearing more or less prominent struts at the proximal end. In the event that the parameres are fused, the resultant structure is referred to in this paper as the apical sclerite.

The female genitalia, on the other hand, are so similar to one another as to be practically useless as taxonomic characters. The ovipositor is almost entirely membranous and is always provided with an apico-lateral pair of 1-segmented styli, each bearing terminal sensory setae. Only in the genus *Diaperis* (pl. 1, fig. 6) is there a radical departure from the conventional form illustrated by *Apsida* (pl. 6, fig. 49).

Techniques.—Genitalia were extracted and prepared for study in the usual manner. Dried specimens were first relaxed in hot water, the elytra spread from above and the contents of the abdomen scooped out along with the dorsal membrane with jeweler's forceps. It was found that this method of extraction left the specimens so unaltered that it would be difficult to detect they had been disturbed in any way. In some instances it was found expedient to remove the entire abdomen; in such cases it was usually possible to reattach the abdomen, leaving the specimen relatively intact.

After removal, the mass of tissue containing the genitalia was placed in a plant industry watch glass containing a 10 percent solution of potassium hydroxide warmed over a desk lamp until the muscular tissue was largely decomposed.

Several stains (mercurochrome and eosin red) were tried as a means of obtaining contrast in the unsclerotized portions of genitalia, but since these tended to obscure more characters than they intensified, the stains were abandoned altogether.

The cleared, unstained genitalia were placed in a drop of glycerine on a glass slide or watch glass, oriented and drawn by means of an ocular micrometer grid disc in a binocular microscope, using coordinant paper to insure accuracy. The outline was transferred to a 2-ply "Strathmore" drawing board and inked. Details were filled in by a compound microscope using reflected light.

In the drawings themselves, intensity of sclerotization is indicated by stippling, heavily sclerotized portions being entirely black and membranous areas left white.

The figures of the adult beetles were drawn on number 1½ and number 2 pebble-grained "Rossboard," using the ocular micrometer grid and coordinant paper essentially as described under genitalia drawings.

The photographs on plate 7 were taken with an Exacta camera

through extension tubes by Dr. John C. Moser, whose generous aid is hereby gratefully acknowledged.

Biology.—Information on life histories, immature stages, and habits of the North American species of Diaperini is extremely fragmentary. Apparently, they are almost all associated with fungi, either feeding on mycelia under bark or in sporophores and occasionally on fungi growing on other organic material. A number of species in the genera *Platydema*, *Neomida*, and *Diaperis* are recorded on fungi in the genera *Polyporus* and *Fomes*. Gebien (1925) has suggested that since both of these fungus genera are distributed throughout the world, there is no doubt but that this alone explains the wide distribution of the Diaperini and the Boletophagini. He supports this dogmatic statement with an impressive list of species of *Polyporus* and *Fomes* along with their world distribution, illustrating the surprisingly wide dispersion of many of them. *Fomes obliquus* Pers., for example, occurs in Europe, North and South America, the West Indies, Africa, Ceylon, and Australia; *Fomes pectinatus* Klotzsch., appears in Europe, North America, Australia, Java, the Philippines, India, and Africa; *Polyporus gilvus* Schwein., appears in North and South America, the West Indies, Africa, Australia, New Guinea, the Malay Archipelago, and East India. Unfortunately it is not known to what extent any of the diaperines are host specific. It remains to be shown by actual tests just how close these relationships are and as yet very few contributions have been made toward this end.

A perusal of the collection data accompanying specimens of North American Diaperini indicates that most of them are to be found in the adult stage the year around, hibernating under bark in the more northern latitudes. Some of them (e.g., *Neomida bicornis*, *Diaperis maculata*, *Platydema ruficorne*, and *P. excavatum*) occasionally congregate in large numbers ostensibly for this purpose.

Two species, *Alphitophagus bifasciatus* (Say) and *Platydema ruficorne* (Sturm), have entered the economic literature as the two-banded fungus beetle and the red-horned grain beetle respectively. Both have been reported on a number of occasions infesting cereal products, but in no instance have they been observed attacking sound grain or freshly milled products. It is only in situations where these products are allowed to accumulate and spoil that the beetles are attracted to them, in all probability to feed upon the attendant fungi rather than the grain products themselves. These beetles are generally regarded as of little or no economic importance.

Specimens studied.—A total of 15,467 specimens of North American Diaperini, supplemented by several thousand specimens from extralimital areas, was studied. New characters which might help place the tribe on a sounder basis were constantly sought. One that has

been almost completely overlooked until now and which was found to be quite valuable, especially in defining generic limits, is the structure of the male aedeagus. More than 300 specimens were dissected so that these structures might be studied.

Several institutions housing important collections were visited for the purpose of examining types: the Horn collection in the Academy of Natural Sciences of Philadelphia, the Casey and Linell collections in the U.S. National Museum, and the LeConte, Haldeman, Melsheimer, and Zimmerman collections in the Museum of Comparative Zoology, Harvard Univ.

The following institutions have lent material, in some instances their entire collections of the group, for this study. In parentheses are the abbreviations used for these institutions when they appear in the text, followed by the name of the person or persons to whom I am indebted for making the specimens available:

Agricultural and Mechanical College of Texas (TAM), H. J. Reinhard
American Museum of Natural History (AMNH), John C. Pallister
British Museum (Natural History) (BMNH), J. Balfour-Browne
California Academy of Sciences (CAS), Hugh B. Leech
Carnegie Museum (CMP), George Wallace
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Emory University (EU), Edward F. Menhinick
Illinois Natural History Survey (INHS), Milton W. Sanderson
Iowa State University (IoSt), Jean L. Laffoon
Kansas State University (KSU), Fred A. Lawson
Michigan State University (MSU), Roland L. Fischer
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Ohio State Museum (OSM), Edward S. Thomas
Ohio State University (OSU), Josef N. Knull
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University of Missouri (UMo), Paul J. Spangler and Wilbur R. Enns
University of Nebraska (UNeb), W. T. Atyeo

Utah State University (Utah), George F. Knowlton

Abbreviations for collectors and collections used in the text are:

C. A. Triplehorn collection (CAT)
Dorothy J. and Josef N. Knull (DJ and JNK)
Musée National d'Histoire Naturelle, Paris (MNHN)
Norma Jean and Elbert L. Sleeper (NJ and ELS)
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Dr. J. Balfour-Browne of the British Museum provided me with a set of the Champion cotypes which are under his supervision and compared specimens with types in the Bates collection at the same institution. His suggestions were most welcome and much credit for the accuracy of many statements contained herein is directly attributable to his keen observations.

The true status of a number of Motschoulsky's species could not have been ascertained without the enthusiastic cooperation of A. Ahelochovtsev and S. Kelejnikova of the Zoological Museum of the University of Moscow, U.S.S.R. The latter's meticulous comparisons of specimens that I submitted with the Motschoulsky types has clarified a number of names which have plagued coleopterists for three quarters of a century.

A. Villiers of the Musée National d'Histoire Naturelle has assisted by comparing specimens with the Chevrolat types.

The many curators of the various North American collections have been especially cooperative in either sending me material for study or in giving me unrestricted use of collections under their supervision. To all of them go my sincerest thanks.

Finally, to my wife, Wanda E. Triplehorn, goes my full measure of gratitude for her help in editing, typing, and checking this manuscript.

Tribe Diaperini Redtenbacher

DIAPERIDES Redtenbacher, 1845, p. 128; 1849, p. 52; 1858, p. cv.—Lacordaire, 1859, p. 298.—Champion, 1886, p. 170.
DIAPERIENS Mulsant, 1854, p. 195.
DIAPERIDAE Thomson, 1859, p. 115; 1864, p. 248; 1868, p. 122.
DIAPÉRITES Jacquelin du Val, 1861, pp. 295, 329.

DIAPERINI LeConte, 1862, p. 236.—Horn, 1870, p. 378.—Redtenbacher, 1874, p. 104.—Seidlitz, 1875, p. 95; 1891, pp. 121, 131; 1894, p. 506.—LeConte and Horn, 1883, p. 383.—Blatchley, 1910, p. 1260.—Reitter, 1911a, p. 338.—Portevin, 1934, p. 23.—Gebien, 1939, p. 765.—Blackwelder, 1945, p. 527.
DIAPERINAE Gebien, 1911, p. 364; 1925, p. 134.—Leng, 1920, p. 233.

Body usually oval and rounded, convex; wings well developed and functional. Head usually retracted into thorax as far as eyes which are emarginate anteriorly (except in *Pentaphyllus*); antennae with outer segments thicker than basal ones, perfoliate, frequently forming a distinct club; mentum small, gular peduncle distinct; genae expanded to cover bases of mandibles which are short and bifid apically; a distinct membranous band present between clypeus and labrum. Pronotum transverse with distinct lateral marginal bead; basal margin bisinuate with a fovea on each side of middle. Elytra evenly convex, never coarsely sculptured, usually punctato-striate, rarely pubescent; epipleura narrow. Prosternum short; prosternal process continuing posteriorly beyond front coxae; mesosternum more or less grooved for reception of prosternal process (except in *Liodema*); anterior coxae subtransverse; hindcoxae strongly and obliquely transverse; anterior prolongation of basal abdominal sternite acute between hindcoxae; tibiae usually slender, spurs fine and short; hindtibiae with finely crenulate ridges on outer margins; tarsi finely pubescent beneath.

TRIBAL LIMITS.—The Diaperini have been treated a number of times on a regional basis, but no recent attempts have been made to correlate the information derived from a study of the world fauna. The present paper can hardly lay claim to such a contribution, but at least a serious attempt has been made to compare the North American components of the tribe with those from Central and South America. Enough northern European species were available to make possible the inclusion of rather valuable, if scanty, information on certain Holarctic genera (i.e., *Scaphidema* and *Pentaphyllus*). Gebien has treated the West African (1920) and the Indo-Malayan (1925) Diaperini and his general considerations and conclusions are supported by and closely parallel those of the present study.

This tribe is difficult to define both in determining its limits and in its relation to other tribes within the subfamily Tenebrioninae. In the past, the character variously expressed as "eyes more conspicuous than sides of front" was used to separate the Diaperini from Phaleriini, Ulomini, and related tribes. This character is misleading and utterly worthless when one compares the small eyes of *Pentaphyllus* and *Scaphidema*, both members of Diaperini, with those of most of the species of *Phaleria* and with many genera of Ulomini.

A very useful character which has been generally overlooked by American workers is the shiny membranous band separating the clyp-

eus and labrum. In all genera which have been studied during the present survey, this structure has been distinctly present and may be used at least for all New World genera of Diaperini. Gebien (1925) reported that it is absent in *Labidocera* Gebien, from the Indo-Malayan region and in *Menimus* Sharp, from New Zealand. Since both of these genera have subsequently been removed from the Diaperini (Gebien, 1940), it is reasonable to assume that all members of the tribe as it is currently understood have the membranous band present.

It is the presence of this membranous band which strongly suggests that the Phaleriini should be united with the Diaperini. In general habitus and in the form of the male aedeagus, species of *Phaleria* are remarkably similar to typical species of *Platydema*. Indeed, many specimens of the former genus were sent along with Diaperini for identification and in one very famous collection, specimens of *Phaleria picipes* LeConte, determined by a distinguished coleopterist as *Platydema laevipes* Haldeman, have stood unchallenged for half a century.

The most constant difference between the two tribes, and the only conceivable reason for retaining them as distinct, is the greatly expanded front tibiae and spiny legs in species of *Phaleria* and related genera. The broad front tibiae are not entirely absent in the Diaperini; several of the dark, chestnut-colored species of *Neomida* from South America (e.g., *N. castanea* Bates and *N. hoffmannseggi* Laporte and Brullé) have these members fully as broadly expanded as in many of the Phaleriini.

A critical study of the relationships between the Diaperini and Phaleriini must be deferred until later, but it seems that there is little justification in retaining them as two distinct tribes.

In all species of North American Diaperini, there is a finely crenulate, sharp margin on the outer face of the hindtibiae. This character was discovered by Gebien (1925), who used it as the decisive one in doubtful cases. On this basis, he removed *Basanopsis* from the Diaperini and transferred it to the Ulomini.

The tribal limits therefore may be stated at this time as consisting of two well-defined characters: (1) the finely crenulate ridges of the hindtibiae and (2) the membranous band between labrum and clypeus.

Based on these criteria, a number of taxa, formerly included in this tribe, must be placed elsewhere. In the North American fauna, the following changes must be made: *Metaclisa* Jacquelin du Val should be placed in the tribe Cnodalonini, and *Corticeus* Piller and Mitterpacher (=*Hypophloeus* Fabricius) should be placed in Ulomini. These two transfers have already been made by Gebien (1940) and appear quite sound.

The species described by Horn (1874) as *Scaphidema pictum* has been transferred to the Phaleriini, where it now stands under the name *Phaleromela variegata* Triplehorn. The biological and nomenclatorial

problems involved in this transfer are discussed elsewhere (Triplehorn, 1961).

The most perplexing task in this revision has been determining the phylogenetic position of *Uloporus ovalis* Casey. No new material has been placed in collections since the original description was published in 1894, despite Casey's contention that the species is "widely diffused throughout the States bordering the Gulf of Mexico." A series of USNM specimens from Columbus, Tex., collected by Hubbard and Schwarz, from which the two specimens forming the basis for Casey's description came, was studied.

Uloporus ovalis possesses a number of features in common with certain species of Diaperini and it is, perhaps, understandable why Casey chose to assign it to this group. A number of these conspicuous features are considered unusual, or at least not typical of the Diaperini. A distinct dorsal vestiture is found in *Pentaphyllus*, *Alphitophagus*, and some of the species of *Neomida;* a 3-segmented antennal club is found in a West Indian genus as yet undescribed; the stout prosternal "bridge" is approached in several genera, especially so in another undescribed West Indian genus. Actually, the peculiar relationship between prosternum and mesosternum seen in *Liodema* is of a more "atypical" form than that of *Uloporus*, and this structure is certainly not of sufficient weight to rule it out of the Diaperini.

The hindlegs (pl. 6, fig. 64b) are quite different from those of any of the Diaperini encountered in this study. The tibiae lack sharp serrulate margins and the second tarsal segment is distinctly lobed beneath.

The male genitalia (pl. 6, fig. 64a) are equipped with prominent claspers which have no counterpart elsewhere in the Diaperini. Claspers of a similar type are found in certain Alleculidae, Melandryidae, and Monommidae, but not to my knowledge in any of the Tenebrionidae.

Except for the character of the legs and male genitalia, Casey's description is, as usual, painstakingly accurate and complete. No new morphological clues have been discovered which would enable, with any degree of confidence the placement of this species in its proper place.

A study of the Neotropical and West Indian Diaperini is under way and it is hoped that, as more is learned about the vast number of genera and species from these areas, the phylogenetic status of *Uloporus* can be determined.

Since this project may require years, it was deemed advisable to proceed with the publication of the remainder of the treatise, recognizing the fact that the retention of *Uloporus* in the Diaperini is

probably incorrect, but deferring its ultimate assignment to avoid possible further confusion.

Sexual dimorphism.—It is noteworthy that among species of Diaperini, it is either very easy or else virtually impossible to distinguish between the sexes without dissection, depending upon the species involved. In almost the entire genus *Neomida* and in quite a few species of *Platydema*, the males are provided with conspicuous frontal horns, whereas the females have either short tubercles instead of horns or no cephalic armature at all. The size of these horns is subject to a certain amount of variation, even among individuals of a single population, but the horns of the male are in all cases quite distinct from the tubercles of the female. This situation largely prevails in these two genera even when considered on a worldwide basis.

In the Indo-Malayan region, Gebien (1925) found species of *Platydema* in which neither the males nor the females are provided with cephalic armature. This is true of 15 of the 19 North American species of *Platydema*. Gebien also reported two distinct species groups of *Platydema* in which the horns of the male were asymmetrical, in one, the right, and in the other, the left, horn being larger. In several species (e.g., *P. monoceros* Gebien) there is but a single frontal horn; in others (e.g., *P. tricuspis* Motschoulsky) there is a rather large horn on the clypeus in addition to the two frontal horns.

An equal range of variation is to be found in *Neomida*, in which the males of almost every species have some sort of frontal or clypeal armature which is totally lacking or but feebly developed in the females.

It is not surprising that great use has been made of these structures. In Gebien's key to the species of *Platydema* of the Indo-Malayan region, they have been used as primary characters so that it would be impossible to determine females unless they could be associated in some way with males.

In *Pentaphyllus pallidus*, the males are provided with short tubercles near the inner margins of the eyes, whereas the females are unmodified in this respect. In *P. californicus* there is no sexual dimorphism.

The males of *Diaperis maculata* have the anterior margin of the pronotum bituberculate at the middle and have two blunt but prominent clypeal tubercles; these same structures are unmodified in females of that species. No sexual dimorphism is evident in any of the other species in the genus.

Probably the most peculiar example of sexual dimorphism is to be found in *Alphitophagus bifasciatus* (Say). The male of this species (pl. 6, fig. 57) has the clypeus greatly swollen and excavated laterally for reception of the prolonged genae. In addition, there are

two short carinate ridges on the frons near the epistomal margin. The head of the female is completely unmodified.

Except for the above-mentioned modifications, there is very little that can be used in separating the two sexes. In North America, this applies to most species of *Platydema*, three of the four species of *Diaperis*, one of the two species of *Pentaphyllus*, and the genera *Palembus*, *Scaphidema*, *Liodema*, and *Apsida*, each represented in our fauna by a single species. If a series is available, it is usually possible to separate most of the males from most of the females by size and shape; the females generally are larger and broader.

Geographic distribution.—Some genera of Diaperini are extraordinarily widely distributed. The ubiquitous genus *Platydema* includes species from every continent and many islands have species which are peculiar to them (e.g., *P. antennatum* Laporte and Brullé, on Cuba). *Neomida* is also cosmopolitan, but contains fewer species. If we exclude the Ulomini with its many species widely dispersed through commerce, the Diaperini are probably the most widespread of all the Tenebrionidae, although a few genera are somewhat restricted. *Cosmonota* is confined exclusively to Central and South America, *Ceropria* to the Old World tropics, and *Scaphidema* to the Holarctic region.

Most of the individual species occupy moderately restricted ranges. Only one, *Alphitophagus bifasciatus* (Say), can be considered cosmopolitan. As might be expected, the tropics of both hemispheres abound in species of Diaperini. The relative paucity of Nearctic species stands in distinct contrast to the bewildering array of Neotropical species, especially in the large genus *Platydema*. *Liodema* and *Apsida*, both moderate-sized genera, each have but one species represented north of the Rio Grande, the remaining species being found only in Central and South America.

The tribe knows no boundaries in North America. Individual species, of course, may be categorized as southern or northern, eastern or western, and very often exhibit interesting distributional patterns. Some (e.g., *Platydema excavatum*, *P. americanum*, *P. rufipes*, and *Neomida bicornis*) have exceedingly wide ranges, whereas others (e.g., *Platydema inquilinum*, *Diaperis rufipes*, and *D. californica*) are extremely localized.

Origin and phylogeny.—It would be impossible at this time to advance a theory as to the origin of the group in its entirety. If we regard as primitive the condition in which the parameres of the male aedeagus are unfused, then the *americanum* group of the genus *Platydema* must be considered the most primitive element. This group certainly has its metropolis in the Nearctic region; 9 of the 19

North American species of the genus are obviously very closely related as indicated by the structure of the male aedeagus (pl. 4) as well as by the unicolorous, shiny dorsal surface. Of the numerous Neotropical species dissected for genitalic studies, none possessed this type of aedeagus. *P. viriditinctum* Champion, from Mexico, is the only other new world species which appears to belong to the *P. americanum* group. This conjecture is based solely on the external morphology of the only specimen available for study, one of Champion's cotypes, which is a female.

It is noteworthy that only two species of this *P. americanum* group, *P. excavatum* and *P. mexicanum*, are found south of the Rio Grande.

Before any broad generalizations can be offered regarding the origin and phylogeny of the tribe, the world fauna must be reviewed in greater detail, particularly in regard to the genitalia. The relationships of the beetles with their host fungi mentioned under the section on biology, when more completely analyzed, will perhaps contribute greatly to our understanding of these interesting but perplexing problems. Any such attempts at this time would of necessity be based on only the most fragmentary evidence and would be highly speculative.

Checklist of North American Diaperini

Diaperis Müller
- *maculata* Olivier
- *californica* Blaisdell
- *rufipes* Horn
- *nigronotata* Pic

Neomida Latreille
- *bicornis* (Fabricius)
- *aeneipennis*, new species
- *ferruginea* (LeConte)
- *myllocnema*, new species

Palembus Casey
- *ocularis* Casey

Platydema Laporte and Brullé
- *excavatum* (Say)
- *teleops*, new species
- *cyanescens* Laporte and Brullé
- *americanum* Laporte and Brullé
- *mexicanum* Champion
- *neglectum*, new species
- *oregonense* LeConte
- *laevipes* Haldeman
- *subcostatum* Laporte and Brullé
- *picilabrum* Melsheimer
- *ruficorne* (Sturm)
- *ruficolle* Laporte and Brullé
- *ellipticum* (Fabricius)
- *flavipes* (Fabricius)
- *nigratum* (Motschoulsky)
- *erythrocerum* Laporte and Brullé
- *wandae*, new species
- *inquilinum* Linell
- *micans* Zimmerman

Scaphidema Redtenbacher
- *aeneolum* (LeConte)

Liodema Horn
- *laeve* (Haldeman)

Apsida Lacordaire
- *belti* Bates

Alphitophagus Stephens
- *bifasciatus* (Say)

Pentaphyllus Dejean
- *pallidus* LeConte
- *californicus* Horn

Incertis sedae: *Uloporus ovalis* Casey

Key to North American Genera of Diaperini

1. Genae entering anterior margins of eyes (only slightly in *Scaphidema*); eyes moderate to large in size and reniform in shape; elytra almost always punctate striate 2
   Genae extending to anterior margins of eyes but not entering them; eyes very small and rounded; elytra confusedly punctured.
   Pentaphyllus Dejean (p. 445)
2. Mesosternum anteriorly notched between middle coxae for reception of posternal process in repose 3
   Mesosternum prolonged cephalad as a rounded lobe which overlaps and conceals prosternal process in repose (pl. 3, fig. 14).
   Liodema Horn (p. 435)
3. Anterior projection of basal abdominal sternite broadly truncate between hindcoxae; all coxae widely separated.
   Scaphidema Redtenbacher (p. 432)
   Anterior projection of basal abdominal sternite acute between hindcoxae; all coxae narrowly separated 4
4. Basal segment of hindtarsus short, subequal in length to second segment. 5
   Basal segment of hindtarsus longer, subequal to or longer than second and third segments combined 6
5. Body broadly oval, strongly convex dorsally, almost hemispherical; elytra boldly patterned with red or orange and black (except *coccinea* Laporte, from South America), shining; never with frontal horns in either sex.
   Diaperis Müller (p. 365)
   Body elongate, cylindrical; elytra always unicolorous; males (at least in North American species) with conspicuous frontal horns between eyes; females with tubercles instead of horns or entirely lacking cephalic armature . . . . **Neomida** Latreille (in part) (p. 374)
6. Epipleura abruptly abbreviated at or near last visible abdominal suture . 7
   Epipleura attaining or almost attaining elytral apices, always distinct well beyond last visible abdominal suture 8
7. Antenna with terminal 5 segments abruptly expanded to form a loose club; body broadly oval, strongly convex dorsally, nearly hemispherical; neither sex with frontal horns . . . . **Apsida** Lacordaire (p. 438)
   Antenna with at least 7 segments expanded to form club; body elongate, cylindrical; males (at least in North American species) with conspicuous frontal horns, females with tubercles instead of horns or entirely lacking cephalic armature . . . . **Neomida** Latreille (in part) (p. 374)
8. Entire dorsal surface with conspicuous vestiture of light colored, short, recumbent setae arising from punctures 9
   Dorsal surface without vestiture 10
9. Elytra bicolored; head of male with clypeus grotesquely swollen and with 2 longitudinal, parallel, carinate ridges on frons near epistomal margin (pl. 6, fig. 57); head of female simple . **Alphitophagus** Stephens (p. 441)
   Elytra unicolorous; head of male with conspicuous frontal horns; head of female horned, tuberculate or unarmed.
   Neomida Latreille (in part) (p. 374)
10. Anterior margin of pronotum truncate or slightly rounded; antenna short, not attaining base of pronotum, outer 7 segments strongly transverse forming a compact club . . . . **Palembus** Casey (p. 387)

Anterior margin of pronotum always distinctly, usually deeply, emarginate; antenna long, always extending beyond base of pronotum, outer segments more gradually clavate . . . . **Platydema** Laporte and Brullé (p. 389)

Genus *Diaperis* Müller

Diaperis Geoffroy, 1762, p. 337 (not binomial, see International Commission . . ., Opinion 228, 1954).—Müller, 1764, p. xv; 1776, pp. xxii, 74.—Fabricius, 1787, p. 21; 1790, p. 216; 1792, p. 516; 1801, p. 585.—Latreille, 1796, p. 21; 1804, p. 306; 1807, p. 176; 1817, p. 301; 1829, p. 29.—Gyllenhal, 1810, p. 549.—Laporte and Brullé, 1831, p. 333.—Laporte, 1840, p. 222.—Redtenbacher, 1845, p. 128; 1849, pp. 52, 590; 1858, pp. cvi, 605; 1874, pp. ii, cxviii, 104.—Mulsant, 1854, pp. 200, 205.—Lacordaire, 1859, p. 301.—Thomson, 1859, p. 116; 1864, p. 250.—Jacquelin du Val, 1861, p. 295.—Seidlitz, 1875, p. 96; 1891, p. 131; 1894, pp. 508, 512.—Desbrochers, 1902, p. 4.—Everts, 1901, p. 256.—Reitter, 1911a, pp. 330, 339.—Gebien, 1925, pp. 142, 155.—Blaisdell, 1929, p. 61.—Portevin, 1934, p. 23.

Type species.—*Chrysomela boleti* Linnaeus (monobasic).

Moderate in size, broadly oval, robust, strongly convex, yellowish to reddish with black markings (except *D. coccinea* Laporte), glabrous, shining. Head greatly deflexed, scarcely visible from dorsal view; eyes large, convex, reniform, anterior margins deeply but narrowly emarginate; antennae with basal segment long, robust, second segment very short and cylindrical, third about twice as long as second and slightly expanded apically, segments 4 to 10 strongly transverse, at least twice as broad as long, forming an abrupt, short, loose club, terminal segment globose, feebly attenuate apically; terminal segment of maxillary palpus narrowly oval, flattened, rounded apically. Elytra punctate-striate, a well defined callosity near middle of basal half. Epipleura broad and flat, abruptly abbreviated at or near last ventral abdominal suture; terminal segment of hindtarsus 1.5 times as long as combined 3 basal segments which are subequal in length. Male genitalia (pl. 1, figs. 2, 3, 7, 8) with lateral lobes fused to form a solid apical sclerite; female genitalia (pl. 1, fig. 6) with a pair of large, heavily sclerotized, toothed lateral processes each bearing a 1-segmented stylus.

The short basal segment of the hindtarsus, the form of the antennae, and the presence of a pair of distinct elytral callosities render this genus quite distinct from other members of the tribe. In addition, it should be mentioned that while the male genitalia do not depart radically from the general pattern in the Diaperini, the large, clawlike lateral processes of the female genitalia are quite distinctive, at least among the North American components of the tribe.

Within limits, the elytral color pattern is quite useful in the separation of species, despite the fact that several of them possess almost identical color patterns (e.g., *D. boleti* and *D. rufipes; D. maculata* and *D. californica*). Fortunately none of these similar species are sym-

patric and, in cases of doubt, there are reliable supplementary characters which may be consulted. Nonrelative definitive characters are not numerous among the species and mainly involve the form of the prosternum, the development of the head, especially the manner in which the genae are raised above the antennal insertions, and of course, the male genitalia. Sexual dimorphism is known only in the North American *D. maculata*.

This genus contains only 12 known species but has an extraordinarily wide distribution. One or more species are found throughout Europe, temperate Asia, China, Japan, Ceylon, North America, the West Indies, Central America, and northern South America. As yet, none are known from either Africa or Australia. They are all remarkably alike in general habitus. All are of at least moderate size, and all except *D. coccinea* Laporte are yellowish to reddish in elytral ground color with distinct patterns of black bands and blotches. The entire dorsal surface of *D. coccinea* (from French Guiana and Brazil) is uniformly light brown in color.

Geoffroy (1762) presented a very clear and adequate diagnosis of the genus *Diaperis*, accompanied by an illustration unquestionably representing *D. boleti*. Since, however, he did not use binomials, the name *Diaperis* must be dated from the next earliest worker, Müller (1764), who validated the name and later (1776, p. 74) included under it *Chrysomela boleti* Linnaeus, which becomes the monobasic type of the genus.

Key to North American Species of *Diaperis*

1. Elytral pattern consisting of 2 continuous, transverse black bands (pl. 1, fig. 5); confined to the southwestern United States and Lower California . . . . **rufipes** Horn
   Elytral pattern consisting of at most 1 continuous, transverse black band located on posterior half of elytra, or entirely lacking transverse bands . . . 2
2. Elytral pattern consisting of a continuous transverse black band on posterior half of elytra and a transverse series of 5 black spots across basal half, the middle one involving both elytra (pl. 1, fig. 4) . . . . . **nigronotata** Pic
   Elytral pattern with large black blotches on posterior half of each elytron which may or may not fuse to form a continuous transverse band; at most, 2 black spots on basal half of each elytron 3
3. Male with apical pronotal margin more or less bituberculate medially and with 2 small tubercles on clypeus; these structures unmodified in female. Ventral surface shining black; head usually bicolored, dark anteriorly, red behind eyes and ventrally. Abundant and widely distributed east of the Mississippi River . . . . ***maculata*** Oliver
   Apical pronotal margin and clypeus unmodified in either sex; ventral surface reddish brown; head uniformly reddish. Known only from four counties in Central California . . . . **californica** Blaisdell

Diaperis maculata **Olivier**

Plate 1 (Figs. 1, 2, 3)

Diaperis maculata Olivier, 1791, p. 273; 1795, p. 5, tab. 1, fig. 2, a, b.—Latreille, 1804, p. 307.—Champion, 1886, p. 174.—Blatchley, 1910, p. 1261, fig. 564.—Blaisdell, 1929, p. 61.
Diaperis hydactina Fabricius, 1798, p. 178.
Diaperis hydni Fabricius, 1801, p. 585.—Laporte and Brullé, 1831, p. 335.—Horn, 1870, p. 379.
Diaperis suturalis Chevrolat, 1877a, p. 170.
Diaperis maculata var. *floridana* Blatchley, 1912, p. 332.—Blaisdell, 1929, p. 61.

Description.—Broadly oval, strongly convex, reddish orange and black, shining. Head with frons flat or slightly concave between eyes; clypeus large, well defined and swollen, with 2 blunt but distinct tubercles in male, simple in female; genae sharply reflected above antennal insertions; antennae dark with basal 2 segments reddish; surface coarsely and densely punctured, color variable but usually dark brown or black anteriorly and red posteriorly from eyes and ventrally, sometimes uniformly reddish. Pronotum shining black, transverse, slightly more than twice as broad as long, apical margin bisinuate, more strongly so in males which in addition are bituberculate medially; basal margin strongly bisinuate, produced in region of scutellum; both basal and apical angles obtuse and broadly rounded; lateral margins moderately arcuate, narrowly expanded, finely beaded; surface finely and rather sparsely punctured. Scutellum black, finely punctulate. Elytra with lateral margins broadly rounded to subparallel; striae finely punctured, not impressed; intervals flat, moderately, coarsely, and densely to minutely, punctured; ground color reddish orange with black markings as follows: a sutural stripe not attaining scutellum, becoming irregularly broader toward apex; a large rounded spot on middle of basal third; usually a small elongate posthumeral spot near margin, a large irregular spot on apical half extending from lateral margin, separated from or fused with sutural stripe. Ventral surface of pronotum slightly concave, finely and rugosely punctured; prosternum very short in front, prosternal process strongly and evenly arcuate between coxae, its apex obtusely deflected and concealed; mesosternum small, deeply notched anteriorly; metasternum and abdominal sternites finely and densely punctured medially, punctures coarser laterally and on pleural sclerites; entire ventral surface and legs dark brown to black, shining. Male aedeagus (pl. 1, figs. 2, 3) with basal sclerite regularly convex behind apical sclerite, deeply and broadly channelled laterally for nearly half its length. Measurements: length 4.7–7.2 mm.; width 2.8–4.6 mm.

Remarks.—The color pattern of the elytra in this species, as in other members of the genus, is quite diagnostic, although not, as Horn (1870) states, "remarkably uniform in its system of elytral coloration." Plate 1 (fig. 1) illustrates what may be considered the typical pattern. The large black blotches on the posterior half of the elytra may be distinct, as shown, or may fuse with the sutural stripe forming a continuous band across the elytra. This character forms a fairly smooth north-south cline (fig. 1). The percentage of available specimens with the apical blotches fused is very low in the northern states and Canada and very high in the southern states. In the West Indies and Central America virtually the entire population has the blotches fused.

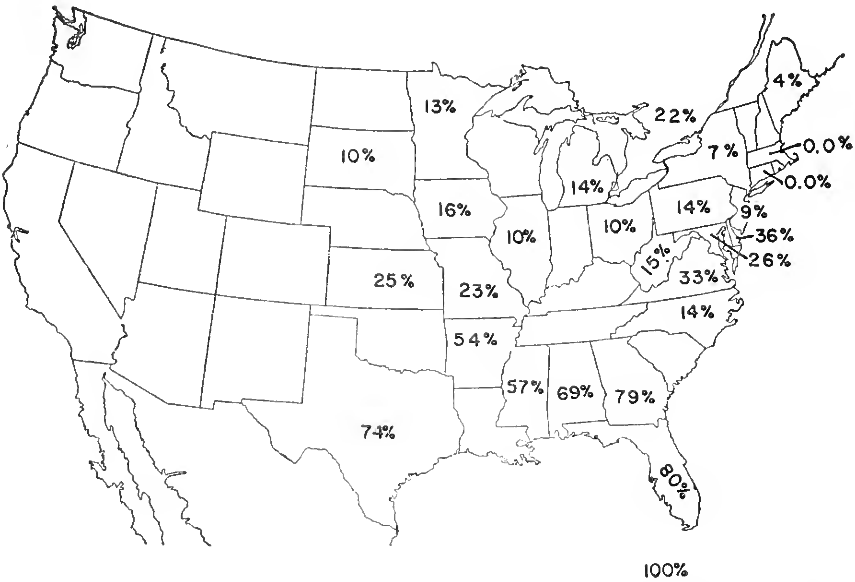

Figure 1.—*Diaperis maculata* Olivier: percentages represent the proportion of specimens from each state having the apical blotches of the elytra fused, based on at least 25 specimens from each state.

The elongate humeral spot, not shown in the figure because of the convexity of the elytra, is usually present and distinct in northern areas but obsolescent or completely absent in individuals from the Deep South, the West Indies, and Central America. Its presence or absence is quite independent of the fusion or separation of the apical blotches, and was omitted from consideration in studying the cline described above. It was to the phase in which the apical blotches are fused and the humeral spots absent that Blatchley assigned the name "*floridana*."

The two Fabrician species, *D. hydactina* and *D. hydni*, both refer to the same insect. In his 1801 paper, Fabricius uses the latter

name, referring it back to his 1798 paper where he had called it *hydactina*. Each name is accompanied by an identical description and designation of locality. Both of these names were preceded by the well-documented and figured Olivier name which thus has priority. Typical specimens of *D. maculata* from Iowa compared well with the type of *D. suturalis* Chevrolat (A. Villiers, in litt.).

This species is very abundant throughout its range, where it completes its entire life cycle in a number of species of fleshy fungi, notably those of the genus *Polyporus*. In the fall, in the northern states at least, large numbers congregate under bark to hibernate. It is also frequently attracted to lights.

Types.—*D. maculata* Olivier: not seen; whereabouts unknown; type locality not given. *D. hydactina* Fabricius and *D. hydni* Fabricius: not seen; type locality, "Habitat in Carolinae Hydna candido." *D. suturalis* Chevrolat: not seen, but specimens compared with type in MNHN by A. Villiers; type locality "Mexico." *Diaperis maculata* var. *floridana* Blatchley: cotypes in Blatchley collection, Purdue Univ.; cotype in H. C. Fall collection, MCZ; type locality, Sarasota, Fla., Feb. 28, 1911, W. S. Blatchley; reported as "frequent beneath bark of fungus-covered log" (Blatchley, 1912, p. 332).

Specimens examined.—From the following localities, 2458:

United States: Alabama (Auburn, Cheaha State Park, Gurley, Mobile, Peterman, Shimek, Tuscaloosa). Arkansas (Barnes, Cove, Hope, Prairie Co., Washington Co.). Connecticut (Cornwall, Litchfield, Stamford, Suffield, Woodmont). Delaware (Newark). District of Columbia. Florida (Big Pine, Brooksville, Dunedin, Eau Gallie, Enterprise, Gainesville, Highlands Hammock State Park, Lake Worth, Miami, Monticello, Newman's Lake, Ocala, Orlando, Paradise Key, Pine, Punta Gorda, Royal Palm State Park, Saint Augustine, Sanford, Sarasota, Torreya State Park, Winter Park). Georgia (Arlington, Athens, Atlanta, Brunswick, Clyo, Savannah, Stone Mountain). Illinois (Equality, Evanston, Glenview, Moline, Mossville, Oakwood, Quincy, Urbana, White Heath, Zeigler, Putnam Co.). Indiana (Lafayette, La Porte, Lebanon, Miller, Vincennes, Crawford Co., Harrison Co., Jennings Co., Kosciusko Co., Lagrange Co., Parke Co., Perry Co., Porter Co., Posey Co., Tippecanoe Co., Vigo Co., Wabash Co., Whitley Co.). Iowa (Ames, Alleman, Cedar Rapids, Fort Dodge, Iowa City, Ledges, Leon, Maxwell, Redfield). Kansas (Chanute, Elmo, Lawrence, Manhattan, Onaga, Topeka). Kentucky. Louisiana (Baton Rouge, New Roads). Maine (Bethel, Bridgton, Casco, Lincoln, Orono). Maryland (Baltimore, Branchville, Odenton, Plummers Island, Sparrows Point, Takoma Park, Frederick Co.). Massachusetts (Agawam, Beach Bluff, Belmont, Blue Hills, Boston, Cambridge, Concord, Dorchester, Framingham, Humarock, Lawrence, Martha's Vineyard, North Saugus, Springfield, Stoneham, Stoughton, Tyngsboro, Wakefield, Wellesley, Wilbraham, Wilmington, Norfolk Co.). Michigan (Ann Arbor, Big Stone Bay, Detroit, Douglas Lake, East Lansing, Grand Ledge, Grand Rapids, Hart, Honor, Owosso, Stony Creek, Cheboygan Co., Eaton Co., Emmet Co., Ingham Co., Kalamazoo Co., Keweenaw Co., Saginaw Co.). Minnesota (Afton, Eitzen, Excelsior, Floodwood, Hokah, Itasca Park, John Latsch State Park, Lakeland, Lake Minnetonka, Minneapolis, Mississippi Bluff, Pine Band, Saint Anthony

Park, Saint Paul, Anoka Co., Dakota Co., Fillmore Co., Goodhue Co., Hennepin Co., Mille Lacs Co., Olmsted Co., Pope Co., Ramsey Co., Scott Co., Sibley Co., Washington Co., Winona Co.). Mississippi (Bruce, Lucedale, Lumberton, Richton). Missouri (Cape Girardeau, Columbia, Marionville, New Hartford, Osage Hills, Saint Louis, Sedalia, Vera, Willard). Montana. Nebraska (Ashland, Lincoln, Nebraska City, Omaha). New Hampshire (Canobie Lake, Claremont, Farmington, Franconia, Milton). New Jersey (Alpine, Billingsport, Boonton, Burlington, Camden, Clementon, Collingswood, DaCosta, Englewood, Fort Lee, Garrett Rock, High Point, Lakehurst, Lake Hoptacong, New Brunswick, Moorestown, Paterson, Phillipsburg, Riverton, Springfield, Tenafly, Westville, Bergen Co.). New York (Allegany State Park, Batavia, Bronx Park, Bronxville, Buffalo, Canton, Chicago Bog, Eltingville, Flatbush, Forest Park, Ithaca, Lancaster, Long Island, McLean, Minetto, Mosholu, New Lebanon, Oakdale, Olcott, Oswego, Portage, Prince Bay, Schenectady, Sunken Meadow State Park, West Point, White Plains). North Carolina (Asheville, Black Mountain, Cherokee, Greensboro, Lake Junaluska, Murphy, Saluda, Swannanoa). North Dakota (Inkster). Ohio (Amherst, Athens, Bainbridge, Bedford, Bluffton, Buckeye Lake, Carbondale, Cedar Point, Clifton, Columbus, Crane Hollow, Dayton, Fort Ancient, Jefferson, Jersey, Lagrange, Lockbourne, Millport, Northfield, Rock Creek, Salem, Sparta, Sugar Grove, Wooster, Champaign Co., Delaware Co., Hocking Co., Holmes Co., Jackson Co., Madison Co., Marion Co., Meigs Co., Scioto Co., Summit Co.). Oklahoma (Big Cedar, Broken Bow, Stillwater, Wyandotte, McCurtain Co.). Pennsylvania (Angora, Chinchilla, Easton, East Berlin, Essington, Glenolden, Harrisburg, Hazleton, Jeannette, Lansdowne, Lime Rock, Ohiopyle, Overbrook, Philadelphia, Pittsburgh, Presque Isle, Shiloh, State College, Tinicum, Wall, Allegheny Co., Crawford Co., Delaware Co., York Co.). Rhode Island (East Providence). South Carolina (Beaufort, Camden, Clemson College, Jackson, Savannah River Plant). South Dakota (Custer State Park, Elmore, Sheridan). Tennessee (Deer Lodge, Perryville). Texas (Anahuac, College Station, Columbus, Dallas, Dickinson, Liberty, Maud, Mexia, Seabrook, Victoria, Willis, Eastland Co.). Virginia (Cape Henry, Cobham, Falls Church, Great Falls, New Market, Loudoun Co., Nelson Co.). West Virginia (Talcott, White Sulphur Springs). Wisconsin (Bayfield, Beaver Dam). Wyoming (Newcastle).

Canada: Ontario (Aylmer, Bells Corner, Lake Simcoe, Muskoka, Osgoode, Picton, Point Pelee, Port Colborne, Port Hope, Strathroy, Toronto, Trenton, Turkey Point, Vineland, Welland). Manitoba (Aweme, Winnipeg). Quebec (Aylmer, Fairy Lake, Fort Coulonge, Laniel, Montreal).

Bahama Islands: Nassau.

Costa Rica: Hamburg Farm, Reventazón.

Cuba: Baños de San Vicente, Cienfuegos, Upper Yara Valley, Isle of Pines.

Dominican Republic: Loma Rucilla, Constanzo.

Jamaica: Kingston, Mandeville, Port Antonio.

Panama: El Real de Santa María.

Puerto Rico: Añasco, Humacao, Mayagüez.

Virgin Islands: Saint Croix.

Diaperis californica Blaisdell

Diaperis californica Blaisdell, 1929, p. 60.

DESCRIPTION.—Elongate oval, strongly convex, reddish orange and black, shining. Head with frons perfectly flat between eyes; clyp-

eus large, well defined and swollen, simple in both sexes; genae feebly reflected above antennal insertions; antennae reddish brown; surface very coarsely and irregularly punctured, uniformly reddish in color. Pronotum dark reddish brown, shining, apical margin simply bisinuate in both sexes, otherwise as in *D. maculata*. Scutellum reddish orange, minutely punctulate. Elytra with lateral margins subparallel; striae rather coarsely punctured, not impressed; intervals flat, moderately, coarsely, and densely punctured; ground color reddish orange with black markings almost identical to and subject to the same variations as those of *D. maculata*. Entire ventral surface reddish brown except for lateral portions of abdominal sternites which may be darker; legs dark reddish brown; otherwise as in *D. maculata*. Male aedeagus indistinguishable from that of *D. maculata*. Measurements: length 5.0–5.8 mm.; width 2.9–3.3 mm.

Remarks.—If only the color pattern and male genitalia were considered, this species probably would be considered a slightly aberrant form of the rather variable *D. maculata*, to which it obviously is closely related. Its surprising occurrence far beyond the westernmost limits of the latter species' range invited the close scrutiny to which Blaisdell subjected it.

It may be distinguished from its eastern relative by a number of quite constant and diagnostic morphological characters. The more parallel form of the body, the unicolorous head, the reddish-brown ventral surface, legs, and pronotum, and the lack of sexual dimorphism (i.e., absence of tubercles on the clypeus and anterior pronotal margin in the male), should readily separate *D. californica* from *D. maculata*. The elongate, posthumeral black spot is always absent or obsolescent, but the size of the apical blotches is variable. In one specimen they fuse with the sutural black stripe; in another they are almost fused with it; in all others they are separated. Thus the species' color pattern falls well within the range of variation exhibited by *D. maculata*.

Types.—Holotype, male, CAS 2617, allotype, female, CAS 2618, and 6 paratypes all from Davis Meadow, near Railroad Flat, Calaveras Co., Calif., July 8, 1907, at 2800 feet, all taken from a large fungus on a dead white oak by Frank E. Blaisdell.

Specimens examined.—13 from the following localities:

United States: California (Stevenson Creek, Fresno Co., at 5000 feet, June 9, 1920, Henry Dietrich (CU, CAT); Placer Co., E. C. Van Dyke (CAS); Chiquito Creek, Madera Co., at 4100 feet, June 22, 1920, Henry Dietrich (CAS).

Diaperis rufipes Horn

Plate 1 (Figs. 5, 6, 7, 8)

Diaperis rufipes Horn, 1870, p. 379; 1894, p. 352.—Blaisdell, 1929, p. 61; 1943, p. 265.

Description.—Broadly oval, strongly convex, reddish orange and black, shining. Head with frons flat or slightly convex between eyes; clypeus large, well defined, feebly swollen, simple in both sexes; genae somewhat reflected above antennal insertions; antennae dark brown with basal 3 segments distinctly reddish; both dorsal and ventral surfaces of head usually uniformly bright red, coarsely and densely punctured. Pronotum shining black, transverse, slightly more than twice as broad as long; apical margin truncate, unmodified in either sex; basal margin strongly bisinuate, produced in region of scutellum; both basal and apical angles obtuse, broadly rounded; lateral margins strongly arcuate, narrowly expanded, finely beaded; surface finely and very sparsely punctured. Scutellum black, a few minute punctures confined to center. Elytra with lateral margins broadly rounded to subparallel; striae unimpressed, composed of fine punctures; intervals flat, finely and sparsely punctulate; ground color reddish orange with two irregular transverse bands continuous across elytra, connected by a narrow sutural black stripe, usually as in plate 1 (fig. 5), but occasionally with the black bands broader than areas of ground color. Ventral surface variable in color, usually black with reddish cast to edges of sclerites, sometimes entirely red; front femora always red, front tibiae and remaining legs variable, dark brown to reddish; basal tarsal segments and claws reddish, apical segment brown or black or each tarsus entirely red. Male aedeagus (pl. 1, figs. 7, 8) with basal sclerite deeply channelled behind apical sclerite; deeply channelled laterally from apex toward base for more than half the length of basal sclerite. Measurements: length 5.2–6.8 mm.; width 3.3–4.2 mm.

Remarks.—This is the only North American species of *Diaperis* having two uninterrupted transverse black bands across the elytra. The coloration is highly variable. Normally the transverse bands are quite distinct and narrower than the reddish-orange ground color, but every variation exists from this to a specimen from Nogales, Ariz. (CAS), in which a narrow basal band and two small apical spots are all that remain of the ground color. The coloration of the legs and ventral surface is also variable, but the front femora are always reddish. Similarly, the normally red head is subject to a certain amount of darkening in some individuals.

Diaperis nigronotata Pic is quite similar, although its anterior elytral black band is broken up into a series of spots (pl. 1, fig. 4) and its overall pigmentation is much more constant.

The well known European species, *D. boleti* Linnaeus, itself quite variable in coloration, is almost identical to *D. rufipes* in its elytral pattern; however, the male genitalia suggest a closer relationship to *D. maculata*. The best morphological character that separates *D. boleti* from *D. rufipes*, and one which has hitherto been overlooked, is the remarkable form of the prosternal process of the former species. Anteriorly, this structure forms a sharp spine in front of the coxae and curves posteriorly between them where the apex is slightly produced, acute, and secondarily reflected. In *D. rufipes* and, in fact, in all North American species, this structure is simply and evenly convex between the coxae, with its apex deflexed and concealed.

The type was collected under cottonwood bark. Other ecological data accompanying specimens were: Tucson, Ariz. (UAriz) "bracket fungus on elderberry"; Blythe, Calif. (UCal) "at light"; Blythe, Calif. (UIda) "under bark of *Populus* sp."; El Centro, Calif. (CAS) "Ex *Polyporus*"; Albuquerque, N. Mex. (CAS) "on Sporophores."

Type.—ANSP 3989; type locality [Camp Grant], Ariz.

Specimens examined.—From the following localities, 94:

United States: Arizona (Arivaipa, Fort Yuma, Oak Creek Canyon, Oracle, Patagonia, Phoenix, Sierra Ancha Mts., Tucson, Washington Mts. near Nogales). California (Blythe, El Centro, Needles). New Mexico (Albuquerque).

Mexico: Baja California (Cape San Lucas, La Chuparosa, San José del Cabo).

Diaperis nigronotata Pic

Plate 1 (Fig. 4)

Diaperis rufipes var. *nigronotata* Pic, 1926, p. 22.
Diaperis rufipes var. *bicoloriceps* Pic, 1926, p. 22.

Description.—Broadly oval, strongly convex, reddish orange and black, shining. Similar to *D. rufipes*, differing from it mainly in the pattern of black markings on elytra, which are as follows: a sutural stripe, uniform in width, ending abruptly in a large blotch embracing both elytra on basal fourth; a small oval spot on each elytron and, in line with it, a large, irregular, marginal spot; a large irregular band on apical half of each elytron continuous across elytra (pl. 1, fig. 4). Front femora always entirely red, except for extreme distal portion which is dark brown; middle and hindfemora and all tibiae dark brown; basal tarsal segments and claws reddish, apical segment brown or black. Male aedeagus indistinguishable from that of *D. rufipes*. Measurements: length 5.1–6.4 mm.; width 3.2–3.9 mm.

Remarks.—The constant and distinctive elytral color pattern of this species is alone sufficiently diagnostic to separate it from any other known species of *Diaperis* in the world. The sculpture of the

male genitalia, the normally uniformly red head and the red front femora all indicate a close affinity with *D. rufipes*, and there seems but little doubt that they have had a common ancestry. They have, however, diverged sufficiently and are distinct enough to warrant specific rank.

The principal variation observed was in the intensity of coloration and in the contrast between ground color and pattern of the elytra. Many specimens were encountered in which the pattern was obscured by an overall darkening of the ground color. *D. bicoloriceps* Pic was described as having the head red behind and dark in front, an unusual but quite normal variation in *D. nigronotata*.

TYPES.—In the private collection of M. Pic of Paris, France. Identification of the initial specimens encountered in this study was verified by Mr. Pic himself. Type locality, "Floride."

SPECIMENS EXAMINED.—From the following localities, 190:

United States: Alabama (Spring Hill). Arkansas (Hope). Florida (Dunedin). Indiana. Iowa (Mount Vernon). Georgia (Athens, Atlanta, Dunwoody, Thomasville). Kansas. Louisiana. Maryland (Baltimore). Minnesota (Houston Co., Ramsey Co.). Mississippi (West Point). Missouri (Columbia). Ohio (Champaign Co., Hocking Co., Scioto Co.). Oklahoma (McCurtain Co.). Pennsylvania (Jeannette). South Carolina (Jackson). Texas (Brownwood, College Station, Dallas, Kingsville, Victoria, Colorado Co., Eastland Co.). West Virginia (White Sulphur Springs).

Genus *Neomida* Latreille

Neomida Latreille, 1829, p. 29.—Mulsant, 1854, p. 217.—Seidlitz, 1894, pp. 528, 532.

Hoplocephala Laporte and Brullé [scr. *Oplocephala*] 1831, p. 338.—Laporte, 1840, p. 222.—Redtenbacher, 1845, p. 128; 1849, pp. 52, 590; 1858, pp. cvi, 604; 1874, pp. ii, cxviii, 105.—Mulsant, 1854, p. 215.—Lacordaire, 1859, p. 302.—Thomson, 1859, p. 116; 1864, p. 248.—Jacquelin du Val, 1861, p. 295.—Horn, 1870, p. 379.—LeConte and Horn, 1883, p. 383.—Seidlitz, 1875, p. 96; 1891, p. 131; 1894, pp. 509, 526.—Gebien, 1925, pp. 143, 448.

Arrhenoplita Kirby, 1837, p. 235.—Champion, 1886, p. 175.—Reitter, 1911a, pp. 331, 340.

Evoplus LeConte, 1866, p. 128.—Bates, 1873b, p. 234.

TYPE SPECIES.—*Ips haemorrhoidalis* Fabricius (monobasic).

Body usually elongate, cylindrical, strongly convex. Head of males with horns or tubercles either on frons or clypeus or on both; head of female usually simple; eyes large, broadly but shallowly emarginate anteriorly; antenna usually with all but basal three or four segments strongly transverse, about twice as broad as long, forming a loose club; terminal segment of maxillary palpus elongate oval, cylindrical, obliquely truncate or rounded apically. Prosternal process convex between front coxae, strongly declivitous immediately behind them, apex usually concealed; mesosternum rather flattened,

V-shaped between coxae, broadly notched in front; epipleura usually abbreviated; terminal segment of hindtarsus at least 1.5 times longer than basal segment which is subequal in length to, or shorter than, the following two segments combined. Male aedeagus with apical sclerite composed of a single piece.

This genus is very difficult to delimit since there are so few characters that are not subject to exceptions. There are many detailed generic descriptions in the literature, but most of them are designed to cover only a limited faunal area and are usually based on the European *N. haemorrhoidalis* (Fabricius). While it is true that most of the species encountered do fit such a description, it was thought best to modify the above diagnosis so as to cover all variations encountered in the present study.

The criteria which most firmly unites members of this genus as a natural group are themselves subject to exceptions. The long, loose antennal club, a character shared with *Diaperis* and similar to those of *Palembus* and *Pentaphyllus*, the relatively short basal segment of the hindtarsus, the presence of horns or tubercles on the frons or clypeus or on both, at least, in the males of every species (except possibly *N. inermis* Champion), the convex prosternal process and the general form of the male aedeagus, all combine to give a very distinct habitus to members of this genus.

Some previous authors have arbitrarily placed all more or less cylindrical species into the genus, but this obscures the relationships and should be avoided. Several members of the genus *Platydema* (e.g., *P. picilabrum*, *P. subcostatum*) are more cylindrical than some of the species of *Neomida* (e.g., *N. myllocnema*, *N. suilla* Champion).

Most species have the epipleura abbreviated near the last ventral abdominal sternite, notable exceptions being *N. picea* (Laporte and Brullé) and *N. myllocnema*, in which the epipleura extend to the apices of the elytra.

Considerable variation exists in the punctation, striation, and dorsal vestiture of the elytra. Most species are typically punctate-striate and glabrous as in *N. bicornis* and *N. haemorrhoidalis*. Others are punctate-striate and clothed with fine setae as in *N. myllocnema* and *N. picea*, while still others are confusedly punctured as *N. inermis* (Champion) and *N. cioides* (Champion).

The cephalic horns, present to some degree in the males of all species of *Neomida*, differ widely in form. The frontal pair may be thin, cylindrical, and straight as in *N. bicornis*, thick, flattened, and blunt as in *N. myllocnema* and *N. suilla*, or long and curved as in *N. ferruginea* and *N. hoffmanseggi* (Laporte and Brullé).

The clypeus may be armed with two small tubercles as in *N. bicornis*, *N. aeneipennis*, and *N. lecontei* (Bates), one median tubercle as in *N.*

picea or none as in *N. hoffmannseggi* and *N. inermis*. In one species from British Honduras, apparently undescribed, both sexes lack frontal horns entirely, but the males have enormously developed clypeal horns.

Frontal horns are also found in some species of *Platydema*, but in that genus they are usually directed sharply forward while in *Neomida* they are porrect or even directed posteriorly over the pronotum. The greater length of the basal segment of the hindtarsus in horned members of *Platydema* will readily exclude them from *Neomida*.

In size, species of *Neomida* vary from less than 2 mm. (e.g., *N. suilla*) to almost 10 mm. (e.g., *N. lateralis* (Bates)).

Despite the great diversity of form in a number of morphological characters exhibited by members of this genus, they form a natural group which at present defies further division.

Most of these characters which look at first glance like good generic differences are found, when traced through the various species, to cut across "generic" limits or to grade imperceptibly from one "genus" into another.

It is perhaps a tribute to the general similarity of habitus expressed by the species of *Neomida* that we are not encumbered by a number of generic and subgeneric names and a longer list of synonyms, despite the number of coleopterists who have contributed new species.

It is regrettable that the well-known and firmly established name *Hoplocephala* must fall and be replaced by the misused and confusing appellation *Neomida*. This must be done, however, since *Neomida* was erected by Latreille (1829) for the validly described *Ips haemorrhoidalis* Fabricius, 2 years before Laporte and Brullé (1831) described *Hoplocephala*. *Arrhenoplita* (Kirby, 1837) is a primary objective synonym and contained only *bicornis* (Fabricius). LeConte (1866) separated his genus *Evoplus* from *Hoplocephala* by the deep postocular pits prominent in *ferruginea* (LeConte) but not distinctive enough to warrant a generic separation. This character is equally prominent in *N. lateralis* (Bates) and *N. lecontei* (Bates).

The name *Neomida* (not Latreille) has been applied to several quite different taxonomic units. Motschoulsky (1873) reserved it for the dull, lustreless species of *Platydema*, while Mulsant (1854) came close to using it in the present sense. He applied the name to a subgenus of *Hoplocephala* to contain one European species, *bituberculata* Olivier, ironically leaving the type species, *haemorrhoidalis*, in the subgenus *Hoplocephala*.

The genus *Neomida* is represented in the world fauna by at least 58 species. Twenty-four of these are from the Old World (Japan, China, Europe, India, Australia, Africa, Madagascar, and islands of the South Pacific). Thirty-four have been described from the New

World, mostly from the tropics. Many species which apparently are undescribed have been examined during the course of the present study so that the above figure has little meaning. The genus is unquestionably of tropical origin. Only 1 species, *N. bicornis,* invades the Nearctic Region to any appreciable extent, and in the Palaearctic Region, only 3 species are to be found. Two species are known from America, north of Mexico, while 2 others, both new to science, are of possible occurrence. They are separated in the following key.

Key to North American Species of *Neomida*

1. Epipleura entire; dorsal surface feebly shining and clothed with fine, short yellowish setae; head armed in both sexes . . . **myllocnema,** new species
   Epipleura abruptly abbreviated at or slightly beyond last ventral abdominal sternite; dorsal surface strongly shining, glabrous; head armed only in male 2
2. Entire dorsal surface reddish brown; head of male with deep, smooth postocular pits, frontal horns flattened and curved posteriorly.
   ferruginea (LeConte)
   Usually entire dorsal surface, but at least elytra, green, blue, or with bronze-green reflections; head of male without postocular pits, frontal horns cylindrical and porrect 3
3. Male with clypeal tubercles prominent and acute (pl. 6, fig. 63); apical sclerite of aedeagus broader than long (pl. 6, fig. 61); both sexes with median portions of abdominal sternites moderately coarsely, and densely punctured, each puncture bearing a very short seta; widespread and abundant in eastern North America. . . . . **bicornis** (Fabricius)
   Male with clypeal tubercles short and blunt (pl. 6, fig. 64); apical sclerite of aedeagus longer than broad (pl. 6, fig. 62); both sexes with median portions of abdominal sternites finely and sparsely punctured, each puncture bearing a long, fine, recumbent seta; Central America as far north as the State of Tamaulipas, Mexico . . . . **aeneipennis,** new species

Neomida bicornis (Fabricius)

Plates 2 (Fig. 9), 6 (Figs. 61, 63)

Hispa bicornis Fabricius, 1776, p. 215; 1781, p. 82; 1787, p. 47.
Hispa cornigera Fabricius, 1781, p. 82; 1787, p. 47.
Diaperis bicornis (Fabricius), Oliver, 1791, p. 273; 1795, no. 55, p. 6, pl. 1, fig. 4a, b.
Diaperis cornigera (Fabricius), Oliver, 1795, no. 55, p. 7, pl. 1, fig. 5a, b.
Diaperis viridipennis Fabricius, 1801, p. 586.
Blaps metallica Palisot de Beauvois, 1805, p. 139, pl. 30b, fig. 2.
Oplocephala viridipennis (Fabricius), Laporte and Brullé, 1831, p. 340.
Oplocephala virescens Laporte and Brullé, 1831, p. 341.
Arrhenoplita bicornis (Fabricius), Kirby, 1837, p. 235.—Blatchley, 1910, p. 1261.
Hoplocephala viridipennis (Fabricius), Horn, 1870, p. 380.
Hoplocephala bicornis (Olivier), Horn, 1870, p. 380.—Seidlitz, 1894, p. 531.—Everts, 1901, p. 258.—Staig. 1940, p. 104, pl. 50.
Oplocephala gracilis Motschoulsky, 1873, p. 467.
Arrhenoplita viridipennis (Fabricius), Blatchley, 1910, p. 1261.

Description.—Elongate oval, very strongly convex, metallic greenish or bluish, sometimes with head, pronotum and scutellum dull to bright red, strongly shining. Head of male with two prominent, cylindrical erect horns directly between eyes, a broad, deep, smooth, sparsely punctulate depression behind and between them; epistomal margin with two prominent, acutely pointed tubercles, entire head surface minutely and sparsely punctulate; female lacking both frontal horns and epistomal tubercles, entire head coarsely and densely punctured; clypeus convex and distinct in both sexes; eyes large and prominent, deeply emarginate anteriorly; mouthparts reddish, maxillary palpi narrowly elongate oval; basal three or four antennal segments paler than remaining ones. Pronotum slightly less than twice as broad as long, sides broadly and angulately rounded, widest just behind middle, marginal bead fine, sharply reflected, basal and apical angles obtusely and broadly rounded, surface coarsely and rather sparsely punctured, punctures gradually larger from disc to lateral areas. Elytra with sides nearly parallel, narrowly margined with bead strongly reflected, striae feebly or not at all impressed, rather coarsely and deeply punctured, intervals flat or subconvex, finely and sparsely punctate. Ventral surface of pronotum convex, coarsely and densely, sometimes rugosely punctured; prosternal process strongly convex, its apex truncate between coxae, not prolonged toward mesosternum; entire ventral surface more or less coarsely and densely punctured; abdominal and metasternal setae, if present, short and inconspicuous; epipleura abruptly abbreviated anterior to apices of elytra. Male aedeagus with apical sclerite broader than long (pl. 6, fig. 61). Measurements: length 2.7–4.8 mm.; width 1.4–2.4 mm.

Remarks.—This is the only shining metallic species of *Neomida* occurring in North America. Its nearest relative appears to be *N. aeneipennis*, which is unknown north of the Rio Grande. Differences between these two are summarized under the description of the latter species.

The most striking variation exhibited by *N. bicornis* is in the coloration of the pronotum, in some specimens being metallic green as on the elytra and in others a brilliant red. It was to the latter phase that Fabricius gave the name *viridipennis*, which has remained unchallenged until now.

The first suspicion that one species with two distinct color phases is involved occurred when a large series containing both phases in addition to several specimens of intermediate coloration (i.e., brownish to brownish-red pronotum) were reared from a single fungus taken near Newark, Del., in 1953. Since then, more than 3000 specimens have been studied and records kept of the pronotal color-

ation in each. The accompanying map (fig. 2) is the result of this study. Percentages refer to the proportion of the total number of specimens from each state in which the pronotum is red or reddish. Fortunately it was possible to classify the pronotal coloration of the vast majority of specimens as either red or green. The small number of intermediate specimens and those which were teneral were excluded from consideration.

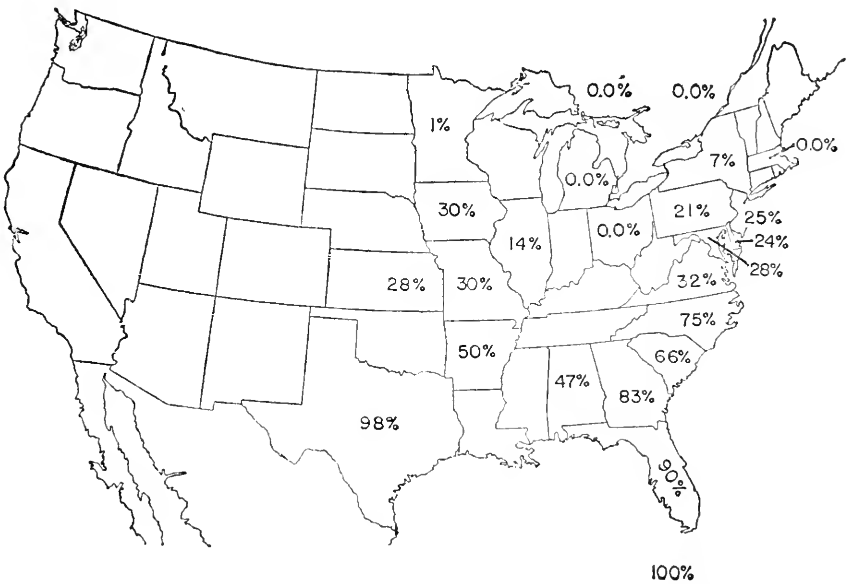

Figure 2.—*Neomida bicornis* (Fabricius): percentages represent the proportion of specimens from each state having red pronota, based on at least 25 specimens from each state.

The character of pronotal coloration forms a distinct north–south cline. In the northern states and Canada, the entire population has the dorsal surface greenish (rarely bluish), while in the West Indies and in the single specimen from Mexico, the pronotum is bright red. Specimens from states between these two extremes fit rather closely the expected curve of character gradient.

There is a source of confusion that perhaps is not readily apparent. It would have been more accurate to have collected data from specific localities rather than from entire states. This would have clarified the situation in such states as Texas and Florida, where the more southern localities should show a higher incidence of individuals with red pronota, but this was not feasible because there were too few large series from specific localities available for study.

Another source of confusion might be the tendency for collectors within a given area to select against the particular form that is

most abundant in the area. A collector in Pennsylvania, for example, having filled in a series of the green phase in his collection would tend to stop collecting and save only the red phase.

While this is perhaps neither the best method of studying this phenomenon nor the most convincing way of analyzing the data, it nevertheless indicates rather conclusively that pronotal coloration cannot be regarded as a reliable criterion for species separation in this genus, and the retention of the two Fabrician names in this case obscures rather than clarifies the situation.

Another interesting variation encountered was the overwhelming preponderance of bluish rather than greenish elytra on specimens from the West Indies. It too is perhaps clinal but is much less understandable than that of pronotal coloration. Specimens with blue elytra occur sporadically even at the northern limits of the range, and a few West Indian individuals have the typical green color. This blue phase was almost certainly the beetle described by Fabricius as *Hispa cornigera* from Cuba. The Fabrician type was figured and redescribed by Olivier (1795). Both the illustration and description compare perfectly with Cuban specimens studied. West Indian specimens average slightly larger than those from the United States.

This is one of our most abundant and widespread species. It has been introduced into various parts of the world, but apparently has never become established. Everts (1903) reported that it was imported into the Netherlands from Havana. Olivier (1795) listed it as "trouvé en Angleterre" under the name *Diaperis cornigera* (Fabricius). Reitter (1885, p. 156) identified specimens imported from Havana into Vienna as *Hoplocephala bituberculata* (Olivier), but Seidlitz (1898) refers these to the North American *Hoplocephala bicornis*. A male in the British Museum collection labelled "Wiens., Reitter," is indeed *N. bicornis*, as is a female from the Cape of Good Hope (Africa) in the same collection.

Types.—None seen. The type specimen of *Hispa bicornis* Fabricius, a male, has been redescribed in minute detail and figured by Staig (1940). It is located in the Hunterian collection at Glasgow Univ. Staig states that this is "presumably the insect described and figured by Olivier." Type locality, North America.

Two Ohio specimens of *N. bicornis* were said to correspond to the type of *Oplocephala gracilis* Motschoulsky, in the UMMZ (Kelejnikova, in litt.). Type locality, Ohio.

Oplocephala virescens Laporte and Brullé was listed by the authors themselves as possibly being a synonym of *Diaperis bicornis*, and the Olivier (1795) figure was cited. Type locality, North America.

The type locality of *Diaperis viridipennis* Fabricius is "North America" and of *Blaps metallica* Palisot de Beauvois, "Caroline du Sud."

Specimens examined.—From the following localities, 3138:

United States: Alabama (Auburn, Mobile, Oxford). Arkansas (Hope). California. Colorado. Connecticut (Cornwall, Hamden, New Haven, Yantic). Delaware (Blades, Felton, Glasgow, Newark). District of Columbia. Florida (Biscayne Bay, Brooksville, Dunedin, Enterprise, Gainesville, Haulover, Jacksonville, Key Largo, Lake Harney, Lakeland, Lake Worth, Lutz, Miami, Ormond, Palatka, Saint Augustine, Sanford, Suwannee, Tallahassee, Tucker, Wakulla Springs). Georgia (Atlanta, Brunswick, Cartersville, Clayton, Dallas, Dunwoody, Griffin, Lakeland, Okefenoke Swamp, Thomasville, Clarke Co.). Illinois (Decatur, Forest Park, Fort Sheridan, Quincy, Saint Joseph, Urbana, Winnetka). Indiana (Lafayette, La Porte, Pine, Gibson Co., Jackson Co., Knox Co., Marion Co., Posey Co., Putnam Co., Spencer Co., Vigo Co.). Iowa (Ames, Cedar Rapids, Gilbert, Herrold, Iowa City, Keokuk, Maxwell, Mount Pleasant, Sioux City). Kansas (Atchison, Benedict, Lawrence, Lone Star, Manhattan, Onaga, Wellington, Geary Co., Gove Co., Neosho Co., Wallace Co.). Kentucky (Louisville, Mammoth Cave). Louisiana (Bogalusa, Doyle, Harahan, Lake Charles, Opelousas, Tallulah, Winnfield). Maine (Norway, Orono). Maryland (Baltimore, Edgewood, Plummers Island, Plum Point, Silver Spring, Sparrows Point). Massachusetts (Arlington, Beach Bluff, Blue Hills, Boston, Cambridge, Dover, Forest Hills, Lawrence, Leeds, Lowell, Nahant, Northampton, Quincy, Salem, Springfield, West Medford). Michigan (Aurelius, Detroit, East Lansing, Galesburg, Kalamazoo, Paw Paw, Cheboygan Co., Clare Co.). Minnesota (Hallock, Itasca Park, Lake Johanna, Lake Minnetonka, Mississippi Bluff, Newport, Pine City, Plummer, Saint Paul, Dakota Co., Fillmore Co., Goodhue Co., Hennepin Co., Houston Co., Mille Lacs Co., Olmsted Co., Otter Tail Co., Rice Co., Washington Co., Winona Co.). Mississippi (Columbia, Hattiesburg, Leaf, Lucedale, Lula, New Augusta, Richton, Hancock Co.). Missouri (Columbia, Des Peres, Kansas City, Rockview, Saint Louis, Springfield, Waynesville). Nebraska (Lincoln, Plattsmouth). New Hampshire (Claremont, Farmington, Franconia, Pike). New Jersey (Boonton, Camden, Chester, Clementon, Dunellen, Egg Harbor, Englewood, Fort Lee, Glassboro, Newark, Riverton, Sandy Hook, South Orange, Split Rock, Westville). New York (Batavia, Brooklyn, Buffalo, Catskill Mts., Dundee, Dunderburg, Elbridge, Flatbush, Fort Niagara, Geneva, Greenport, Greenwood Lake, Hamburg, Ithaca, Keuka Park, Lancaster, Long Island, McLean, New York City, Olcott, Parksville, Potsdam, Rosedale, Sag Harbor, Shokan, Staten Island, Unionport, West Point, Greene Co.). North Carolina (Asheville, Chapel Hill, Ellenboro, Murphy, Raleigh, Saluda, Tryon). Ohio (Athens, Buckeye Lake, Cleveland, Columbus, Crane Hollow, Dayton, Georgesville, Holgate, Jefferson, Lagrange, Millport, North Kingsville, Urbana, Westerville, Adams Co., Allen Co., Delaware Co., Hocking Co., Jackson Co., Morrow Co., Perry Co., Scioto Co.). Oklahoma (Ada, Fort Gibson, Page, Payne Co.). Pennsylvania (Bustleton, Castle Rock, Collingdale, Easton, Harrisburg, Ingram, Jeannette, Lawndale, Milford, Mount Airy, Philadelphia, Pittsburgh, State College, Tinicum Island, Uniontown, Wyoming, Allegheny Co., Delaware Co., Erie Co., York Co.). Rhode Island (Barrington, Kingston, Providence). South Carolina (Camden, Clemson, Georgetown). South Dakota (Vermillion). Tennessee. Texas (Austin, Beaumont, Dallas, Denison, Harrisburg, Houston, Liberty, Paris, Seabrook, San

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Felipe, Seguin, Victoria). Utah (Emery Co.). Virginia (Arlington, Clapham Junction, Falls Church, Fredericksburg, Newport News, Norfolk, Rosslyn, Warrenton, Virginia Beach). West Virginia (Cheat Mts., Fairmont, Harpers Ferry, Justice, Morgantown).

Canada: Nova Scotia (Truro). Ontario (Cobourg, Grimsby, Leamington, Ottawa, Picton, Port Colbourne, Toronto, Trenton, Vineland, Hastings Co., Prince Edward Co.). Quebec (Aylmer, Coteau Junction, Fairy Lake, Gracefield, Hemmingford, Hudson, Hull, Knowlton, Montreal).

Cuba: Cienfuegos, Buenos Aires, Havana, Pico Turguino, Cienagade Zapata, Sierra de Los Organos, San Vicente, Isle of Pines.

Jamaica: Balaclava, Bath, Kingston, Mandeville, Old Harbor.

Bahama Islands: Andros.

Bermuda.

Neomida aeneipennis, new species

Plate 6 (Figs. 62, 64)

Arrhenoplita bicornis (Fabricius), Champion, 1886, p. 175 [misidentification].

Description.—Elongate oval, very strongly convex, light golden brown to dark metallic green, strongly shining. Head of male with two prominent, cylindrical, erect horns directly between eyes, a broad and deep, smooth, sparsely punctulate depression behind and between them; epistomal margin with two short, obtusely pointed tubercles, entire head surface minutely and sparsely punctulate; female lacking both frontal horns and epistomal tubercles, entire head surface coarsely and densely punctured; clypeus convex and distinct in both sexes; eyes large and prominent, deeply emarginate anteriorly; mouthparts reddish, maxillary palpi narrowly elongate oval; basal three or four antennal segments and sometimes apical one, all or in part reddish or at least paler than intervening segments. Pronotum slightly less than twice as broad as long, sides broadly and angulately rounded, widest just behind middle, marginal bead fine, sharply reflected, basal and apical angles obtusely and broadly rounded, surface coarsely and rather sparsely punctured, punctures gradually larger from disc to lateral areas. Scutellum always reddish. Elytra with sides nearly parallel, narrowly margined with bead strongly reflected, striae feebly or not at all impressed, rather coarsely and deeply punctured, intervals flat or subconvex, usually minutely and sparsely punctulate. Ventral surface of pronotum convex, coarsely, densely, sometimes rugosely, punctured; prosternal process strongly convex, its apex truncate between coxae, not prolonged toward mesosternum; medial portions of metasternum and abdominal sternites finely and sparsely punctate, sparsely clothed with conspicuous, pale, very fine, semierect setae which are easily rubbed off; lateral portions of metasternum and entire metepisternum coarsely punctured; epipleura abruptly abbreviated anterior to apices of elytra. Male aedeagus with apical sclerite longer than broad (pl. 6, fig. 62). Measurements: length 4.0–5.2 mm.; width 1.9–2.6 mm.

REMARKS.—This species is so similar to *N. bicornis* in general facies that, following Champion (1886), the Central American specimens were regarded as conspecific with those from the United States. An apparent reversal of the cline described under *N. bicornis* inspired further investigation, ultimately leading to the conclusion that two distinct species were involved.

Champion could find no differences between the two, other than the larger size of Central American specimens (4–5 mm.) compared to that of those from the United States (3.5–4.0 mm.). He also mentioned that the horns of the former are stouter, a character which cannot be confirmed in the present study.

Differences in size and coloration, while relative in nature and subject to considerable overlapping, are quite striking when large series of each species are available. *N. aeneipennis* ranges from 4 to just over 5 mm. in length and is usually more or less bronzed in color while *N. bicornis* ranges from 2.7 to 4.8 mm. in length and is always a brilliant blue or green except in teneral individuals.

Males are easily distinguishable. The genitalia are diagnostic and should always be examined in cases of doubt. In *N. aeneipennis* (pl. 6, fig. 62), the apical sclerite is longer than broad; in *N. bicornis* (pl. 6, fig. 61), it is broader than long. In *N. aeneipennis* the epistomal tubercles are short and obtuse (pl. 6, fig. 64), while those in *N. bicornis* are long and acute (pl. 6, fig. 63.).

In both sexes in *N. aeneipennis*, the abdominal sternites are finely and sparsely punctured and clothed with rather conspicuous setae, while in *N. bicornis* these sternites are coarsely and densely punctured and the setae are much less prominent.

Insofar as locality records are available, *N. bicornis* and *N. aeneipennis* are completely allopatric. Specimens of the latter have been taken as far north as 20 miles north of El Limón, Tamaulipas, Mexico, but only one specimen (labelled "Mex." in MCZ) of *N. bicornis* has been seen south of the Rio Grande.

TYPES.—Holotype male and allotype female (BMNH): Rio Hondo, British Honduras, Blancaneau. Paratypes: British Honduras, 2 males, 3 females, Rio Hondo, Blancaneau (BMNH); 1 male, same data (MCZ); 1 female, Belize, Blancaneau (BMNH); 2 males, 5 females, M[ana]tee Dist[rict], August 1905 (Bowditch collection, MCZ); 1 male, 1 female, same data (CAT); 2 males, M[ana]tee Dist[rict] (Bowditch collection, MCZ).

OTHER SPECIMENS EXAMINED.—From the following localities, 50:

Mexico: 1 male, 1 female, 18 miles south of Tamazunchale, San Luis Potosi, Nov. 22, 1946, E. S. Ross (CAS). 1 female, 20 miles north of El Limón, Tamaulipas, Nov. 10, 1946, E. C. Van Dyke (CAS). 1 female, Tamazunchale, at 500 feet, June 18, 1937, M. A. Embury (Van Dyke collection, CAS). 1 female,

Tampico, July 12, E. A. Schwarz (USNM). 4 males, 1 female, Cordova, Sallé (BMNH). 2 females, Tuxtla, Sallé (BMNH). 1 female. Temax, northern Yucatan, Gaumer (BMNH). 1 male, 1 female, Jalapa, Höge (BMNH).

Guatemala: 5 males, 1 female, Zapote, G. C. Champion (BMNH). 1 male, 2 females, Zapote, G. C. Champion (MCZ). 1 female, Zapote. G. C. Champion (USNM). 1 male, Capetillo, G. C. Champion (BMNH). 1 male, Guatemala City, G. C. Champion (BMNH).

Nicaragua: 1 male, 1 female, Ometepe (Wickham collection, USNM). 1 female, Ometepe (Sharp collection, BMNH).

Neomida ferruginea (LeConte)

PLATE 6 (FIG. 60)

Evoplus ferruginea LeConte, 1866, p. 128.—Bates, 1873b, p. 234.
Evoplus ferrugineus (LeConte).—Horn, 1870, p. 366.
Oplocephala castanea Motschoulsky, 1873, p. 467.
Arrhenoplita ferruginea (LeConte).—Champion, 1886, p. 176.

DESCRIPTION.—Elongate oval, very strongly convex, light reddish brown to dark chestnut, shining. Head of male with 2 elongate, stout, laterally compressed, caudally arcuate horns between and in contact with eyes; clypeus rectangular, convex, with 2 short, obtuse tubercles on outer edges; eyes feebly emarginate anteriorly, a very pronounced, broad, deep concavity immediately behind each, dorsal portions small, narrow, widely separated, ventral portions large and convex; genae broadly flattened, slightly raised and reflected above antennal insertions; mouthparts and antennae uniformly yellowish brown, maxillary palpi narrowly elongate oval; mandibles strongly angulate near base dorsally, projecting beyond lateral margins of apex of epistoma and base of labrum; entire head surface finely and sparsely punctured; head of female lacking both frontal horns and epistomal tubercles but with a feeble elevation at inner margins of eyes and, at most, a feeble suggestion of postocular pits; entire anterior margin of head evenly arcuate from eye to eye; head surface coarsely and densely punctured, punctures becoming confluent between eyes; otherwise as in male. In both sexes, pronotum about 1.5 times as broad as long, sides strongly and evenly rounded, widest just behind middle, finely margined, bead sharply reflected, anterior margin truncate or slightly arcuate medially, basal margin feebly bisinuate, all angles broadly and obtusely rounded, surface coarsely and densely punctured, especially on lateral areas. Elytra with sides straight and parallel, narrowly and sinuately margined, bead sharply reflected; striae distinctly impressed, coarsely, deeply, and closely punctured, intervals convex, finely and rather densely punctulate; ventral surface of pronotum thick, convex, rather coarsely and densely punctured except for large, smooth, convex area extending outward from coxae; otherwise ventral surface generally coarsely and moder-

ately densely punctured; prosternal process convex between coxae, its apex truncate, not prolonged toward mesosternum; anterior tibiae with conspicuous mat of dense golden hairs on anterior surface, outer apical angle noticeably expanded and strongly denticulate; epipleura abruptly abbreviated anterior to apices of elytra. Male aedeagus (pl. 6, fig. 60) extremely long and narrow, apical sclerite, comprising about ⅕ total length of aedeagus. Measurements: length 3.5–5.3 mm.; width 1.6–2.4 mm.

Remarks.—This species possesses so many distinctive characters that LeConte erected a new genus (*Evoplus*) to receive it. The deep postocular pits of the male are sufficient to separate it from most other New World species of *Neomida*, with the exception of *N. lecontei* and *N. lateralis* from Colombia, both described by Bates. I have studied a series of 36 specimens from Jamaica (MCZ) that were determined as *N. lecontei* and were verified by J. Balfour-Browne, who compared them to types in the British Museum. The two species are so closely related that they can be separated only by several relative but constant characters which apply equally to males and females. In general, it can be stated that the sculpture and punctation of the entire dorsal surface of *N. ferruginea* is coarse, while that of *N. lecontei* is quite delicate. Salient differences may be summarized as follows: punctures of pronotum coarse and dense in *N. ferruginea,* fine and sparse in *N. lecontei;* elytral striae impressed and coarsely punctured in *N. ferruginea,* unimpressed and finely punctured in *N. lecontei;* elytral intervals distinctly convex and conspicuously punctate in *N. ferruginea,* flat and obscurely punctate in *N. lecontei.* Each species is remarkably constant in regard to these characters and no intergradation in them was observed. The male genitalia appear to be identical.

In males of both species, the cephalic armature is often poorly developed, rendering the postocular pits proportionately more shallow.

Types.—*Evoplus ferruginea* LeConte, MCZ 4671. A male bearing an orange disk label signifying "Southern States"; the original description lists "Louisiana, Wapler and Guex." Also in the LeConte collection (MCZ) are 1 male and 2 females with the same data as the type, and 1 male and 2 females from Enterprise, Fla., May 26. *Oplocephala castanea* Motschoulsky; type locality, "Nouvelle-Orleans en Louisiane." S. Kelejnikova pronounced specimens of *Neomida ferruginea* (LeConte) from Brownsville, Tex., which agreed perfectly with the description, to be conspecific with the type, a female (UMMZ).

Specimens examined.—From the following localities, 186:

United States: Alabama (Mobile). Florida (Dunedin, Enterprise, Gainesville, Lakeland, Paradise Key, Marion Co.). Louisiana (Opelousas). Texas (Brownsville, Liberty, Tedor, Victoria, Hidalgo Co.).

Cuba: Soledad.

Haiti: Ennery.

Mexico: Mazatlán, Veracruz.

British Honduras: Manatee District.

Neomida myllocnema, new species

Plate 6 (Fig. 59)

Description.—Elongate parallel, moderately convex, very feebly shining. Head of male with two thick, blunt, arcuate frontal horns in contact with eyes; frons abruptly and deeply excavate between horns; clypeus well defined, transverse, with two prominent, narrowly separated tubercles on epistomal margin; eyes large, narrowly and deeply emarginate anteriorly, dorsal portion less than ⅕ the size of ventral portion; antennae very slender, segments 5 to 11 broader than long; terminal segment of maxillary palpus small, narrowly oval; surface of head finely and densely punctured except frontal excavation which is smooth and quite shiny; head of female with large but short and broad, blunt tubercles instead of horns, frons regularly concave between them but not abruptly excavate; epistomal tubercles short and obtuse; entire head surface coarsely and densely punctured; otherwise as in male.

Pronotum transverse, slightly more than 1.5 times as broad as long, widest at base, lateral margins almost straight, feebly convergent from base to apex, finely beaded; apical margin rounded, slightly angulate medially; base almost straight; apical angles broadly rounded, basal angles right-angled; entire surface uniformly coarsely and densely punctured. Elytra subparallel, narrowed at base, lateral margins with thin but prominent, strongly reflected bead, humeral angles sharply rectangular, striae feebly impressed on disk, becoming rather deep apically; strial punctures fine and widely spaced; intervals convex, quite strongly so apically, finely and densely punctulate. Entire dorsal surface clothed with fine but prominent yellowish setae arising from punctures.

Ventral surface of pronotum convex, edges thickened, coarsely and rugosely punctured; prosternal process convex between coxae, its apex deflected and acute, slightly prolonged behind; metasternum and abdominal sternites finely and sparsely punctured medially, punctures coarser and more closely spaced on pleural sclerites and lateral portions of abdominal sternites; entire ventral surface and all appendages, slightly lighter than dorsum; epipleura entire, rather prominent all the way to elytral apex; anterior femora conspicuously

thickened, especially in males where they are also slightly curved; all tibiae slender in both sexes except anterior pair in male, where they are slender and cylindrical on basal half, strongly curved and distinctly flattened and expanded apically, inner margin finely denticulate, inner apical angle drawn out to a prominent point. Male aedeagus (pl. 6, fig. 59) relatively small, fusiform. Measurements: length 4.3–4.6 mm.; width 1.9–2.3 mm. (Holotype 4.4, 2.2 mm.; allotype 4.5, 2.2 mm.)

Remarks.—This is by far the most distinctive member of the genus *Neomida* in the Nearctic Region. Most of the characters which are exhibited by it have their counterpart in other species as, for example, the entire epipleura, frons armed in both sexes, pubescent dorsal surface and modifications of the front legs in one or both sexes, but in no other species encountered in this study are so many divergencies from the conventional generic pattern to be found.

Types.—Holotype male and allotype female, USNM 66047: Santa Rosa, Low[er] Cal[ifornia]. Paratypes: 1 male and 1 female, L[ower] Calif[ornia], August 1901 (CAT); 1 male and 1 female, same data (CU); 1 male, Santa Rosa, Low[er] Cal[ifornia], September (CAS); 1 female, Santa Rosa, Low[er] Cal[ifornia] (CAS); 1 female, Mazatlán, Mexico, Mar. 28, 1918 (CAS); 1 male, 1 female, Santa Rosa, L[ower] Calif[ornia] (MCZ, H. C. Fall collection).

Specimens examined.—Eleven.

Genus *Palembus* Casey

Palembus Casey, 1891, p. 65.

Type species.—*Palembus ocularis* Casey (monobasic).

Elongate parallel, moderately convex, feebly shining. Head rather short and broad, unarmed in either sex; eyes very large and coarsely faceted, separated both dorsally and ventrally by less than the longer axis of one eye, anterior margin broadly and deeply emarginate; terminal segment of maxillary palpus elongate oval, slender, its apex obliquely truncate; antennae with segments 5 to 11 strongly transverse, forming a loose, parallel club. Pronotum transverse, about 1.7 times as broad as long, basal and apical margins equal, sides feebly arcuate. Elytra very long, nearly 3.5 times as long as the pronotum, lateral margins parallel. Prosternal process narrow between coxae, its apex deflected, blunt, not produced; mesosternum flattened, narrowly V-shaped; epipleura entire; femora flattened, distinctly claviform; hindtarsi long, basal segment equal to following two combined, only slightly shorter than terminal segment.

This genus is very closely allied to *Neomida*, differing from it primarily in the unarmed condition of the head in either sex, the more

elongate and depressed form, and the relatively enormous, coarsely faceted eyes.

The one species known to science occurs in Florida and the West Indies.

Palembus ocularis Casey

PLATES 2 (FIG. 10), 3 (FIG. 21)

Palembus ocularis Casey, 1891, p. 65.—Wolcott, 1948, p. 328.

DESCRIPTION.—Elongate parallel, moderately convex, light reddish brown, glabrous, shining. Head feebly and evenly convex; clypeus large, well defined, convex, anterior margin feebly rounded, posterior angles almost in contact with eyes; genae flat, horizontal; antennae and mouthparts reddish brown; punctures fine and dense on clypeus and genae, coarser and more widely spaced on frons. Pronotum transverse, apical margin broadly and evenly but feebly arcuate, base feebly bisinuate; lateral margins slightly arcuate, not at all expanded, widest near middle; both basal and apical angles obtuse, broadly rounded; a very fine bead continuous around entire pronotum; surface finely and densely punctured with conspicuous microreticulations between punctures. Elytra elongate, lateral margins parallel, bead fine and strongly reflected; striae feebly impressed, rather coarsely punctured; intervals slightly convex, finely and sparsely punctate with minute reticulations between punctures. Ventral surface of pronotum convex, finely and rugosely punctured; entire ventral surface light reddish brown, coarsely and densely punctured, including the entire epipleura, microreticulations between punctures; tibiae straight except anterior pair which are slightly bowed at base. Male aedeagus (pl. 3, fig. 21) long and narrow, apical sclerite comprising more than one third the total length, truncate at base, acute apically, penis membranous, the struts very fine. Measurements: length 3.5–4.3 mm.; width 1.3–1.6 mm.

REMARKS.—This very distinct species apparently is not as rare as cabinet material indicates. Wolcott (1948), in Puerto Rico, found both adults and larvae feeding on seeds of tamarind (*Tamarindus indica* Linnaeus) at Loíza and at Faro de Cabo Rojo. He also reported it from "on ground" at Point Cangrojos and on sedges at Ponce and at Cabo Rojo.

The number of specimens accompanied by data listing tamarind as the host suggests that there is probably more than a superficial or accidental association between the beetle and the plant. Tamarind, a member of the Leguminosae, is a native of the Old World tropics and has been naturalized in southern Florida, including the Keys, the West Indies, Mexico, Central and South America. It is possible that

the beetle is of Old World origin, but there is no evidence to support such a conjecture.

Type.—USNM 46806 (Casey collection); type locality, Florida. The specimen has the entire area between prosternum and abdomen obscured by the mounting medium; otherwise, all characters are clearly evident.

Specimens examined.—From the following localities, 17:

United States: Florida (Key West, Tampa (from Mariel, Cuba)).
Bahama Island: Nassau.
Leeward Island: Montserrat.
Jamaica: Kingston.
Puerto Rico: Ponce, San Juan.

Genus *Platydema* Laporte and Brullé

Platydema Laporte and Brullé, 1831, pp. 332, 350.—Redtenbacher, 1845, p. 128; 1849, pp. 52, 591; 1858, pp. cvi, 604; 1874, pp. cxviii, ii, 106.—Mulsant, 1854, pp. 200, 211.—Thomson, 1859, p. 116; 1864, p. 252.—Lacordaire, 1859, p. 304.—Jacquelin du Val, 1861, p. 297.—Horn, 1870, p. 380.—Seidlitz, 1875, p. 97; 1891, pp. 131, 516; 1894, pp. 508, 518,—Champion, 1886, p. 181.—Desbrochers, 1902, p. 7.—Blatchley, 1910, p. 1262.—Reitter, 1911a, pp. 330, 339.—Chatanay, 1914, pp. 475, 484.—Carter, 1917, p. 702.—Gebien, 1920, p. 25; 1925, pp. 143, 539.—Portevin, 1934, p. 25.
Typhobia Pascoe, 1869, p. 279.
Neomida Motschoulsky, 1873, p. 476 (not Latreille, 1829).—Melsheimer, 1846, p. 61.
Histeropsis Chevrolat, 1878b, p. 221.

Type species.—*Platydema dejeani* Laporte and Brullé (original designation).

Elongate oval to broadly oval, moderately convex, strongly shining to dull and lustreless. Eyes moderate to large, emarginate anteriorly; antennae relatively slender, slightly clavate, segments 5 to 10 subequal in size or becoming increasingly broader. Prosternal process prominent, prolonged caudally horizontal or deflected behind front coxae; mesosternum deeply excavate anteriorly for reception of prosternal process; anterior extension of basal abdominal sternite acute between hindcoxae; epipleura entire or abbreviated very close to elytral apices; hindtarsi long, basal segment longer than two following segments combined and usually longer than terminal one; tibiae all relatively slender.

This is by far the largest genus included in the Diaperini, containing 281 species (Gebien, 1940), distributed throughout the world. An all-encompassing diagnostic description of the generic characters involved would be impossible at this time. The above description is based largely on the Nearctic species supplemented by a number of Central and South American components. Only a few Old World

species were available for study, so it is not known to what extent they would conform to the present treatment.

The relatively slender antennae, entire epipleura, well-developed prosternal process and elongate basal segment of the hindtarsi should serve to separate species of *Platydema* from other genera of Diaperini in most instances. Even these characters are subject to a certain amount of variation, so that it is necessary to consider them in combination when dealing with many of the species in order to determine to which genus they belong. As was mentioned previously, *Platydema* and *Neomida* are for the most part distinct enough. Certain species of the latter overlap the former genus in regard to a number of characters so that it becomes difficult to establish clearly defined generic limits. *Platydema* is much more homogeneous and, at least in regard to the above mentioned characters, is relatively stable. Reasons for the retention of the two genera as distinct despite this apparent interdigitation at the fringes are summarized under *Neomida*.

Cosmonota Blanchard, a small neotropical genus containing nine species, is even more difficult to separate from *Platydema*. As Lacordaire (1859) points out, these insects are extremely closely related to *Platydema*, and are distinguished more by their general form and system of coloration than by any precise characters.

It is not surprising that various workers have attempted to divide this unwieldy genus. There are a number of variable characters which would seemingly afford good generic or at least subgeneric criteria. Again, much the same situation prevails here as was encountered in the generic characters discussed under *Neomida*. Division of the genus based on any single arbitrarily selected character would be vastly different from the system derived by the utilization of another character. For example, if we used the armed condition of the head (frontal horns in males, tubercles in females) as a generic or subgeneric character, we would place *P. excavatum*, *P. teleops*, *P. cyanescens*, and *P. erythrocerum* in one group. A study of the genitalia of the males of these species (pl. 4, figs. 22, 23, 24, pl. 5, figs. 43, 44) indicates almost conclusively that the armed condition of the head has originated at least twice in the evolution of the genus *Platydema*, and that, whereas the other three-horned species are quite closely related, *P. erythrocerum* is widely divergent from them and should properly be placed near *P. flavipes* and *P. nigratum*.

Surface lustre has been suggested as a useful criterion for dividing the genus, not without considerable merit. Motschoulsky (1873) proposed the name *Neomida* (a most unfortunate choice) for all of the dull lustreless species and reserved *Platydema* for the shiny ones.

Chevrolat (1878) suggested a similar system in which the dull

species would be included in *Platydema* and the shiny ones in his own genus, *Histeropsis*. Unfortunately, he did not follow his own system himself and, as a result, it is exceedingly difficult to interpret the results of his studies.

Judging from the description, Pascoe's genus *Typhobia*, based on *T. fuliginea* from Queensland, Australia, is a good *Platydema*. It was distinguished from *Diaperis* by the fact that all the antennal segments except the terminal one were obconical.

For the North American species of *Platydema*, the surface lustre character works reasonably well, except for a few species which are either lustreless or only feebly shining but which actually belong to the shiny group and vice versa. The fact that it is a useful character cannot be denied. Virtually every worker has utilized it in some way in his key to the species, a situation which could not be avoided even in this study of the limited Nearctic components of the genus, but it does not seem that it can be applied successfully at the generic level.

The most satisfactory course is to regard *Platydema* as a large natural group, insufficiently understood at present to divide or to attempt, by studying male genitalia, surface lustre, and coloration, to define species groups. This was done rather sucessfully by Gebien (1925) for the Indo-Malayan species. He divided them into three groups which he regarded as natural:

1. Patterned, or at least pigmented species which are not metallic.
2. Metallic or shining black species.
3. Species with dull colored elytra.

Much the same classification was followed earlier by Champion (1886), who divided the Central American components of the genus into five groups:

1. Head of males horned or tuberculate.
2. Dorsal surface unicolorous, shining.
3. Dorsal surface unicolorous, lustreless.
4. Dorsal surface maculated, shining.
5. Dorsal surface maculated, lustreless.

A similar system can be applied arbitrarily to the 19 North American species. Two broad groups may be recognized:

1. More or less shining species having the apical sclerite of the male aedeagus composed of two lateral lobes (*P.* "*americanum*" group).

2. More or less dull, lustreless species having the apical sclerite composed of a single piece (*P.* "*ruficorne*" group).

The *P.* "*americanum*" group is quite homogeneous, all members being closely related and similar in general habitus. The other nine species comprising the *P.* "*ruficorne*" group are rather heterogene-

ous, with several distinct elements present, but all are derivable from a common ancestral type. When the Neotropical species are better known, it is probable that this second group may be further subdivided. The accompanying phylogenetic tree (fig. 3) for the genus is thought to be a reasonably accurate portrayal of the *P. "americanum"* group, whereas the placement of the other nine species comprising the *P. "ruficorne"* group is highly speculative, especially in regard to *P. inquilinum* and *P. micans*.

In the final analysis, the male genitalia seem to hold the key to the broad classification of this genus. In most cases (notably the *P. "americanum"* group) there are other more useful characters to distinguish between species. No new characters were discovered during the course of the present study, except the relative distance separating the eyes when viewed from below, a function of the size of the lower lobe of the eye. To arrive at an index, the specimen is turned upside down so that both eyes are entirely in view and then adjusted so that both eyes measure the same with an ocular micrometer. The longer axis of one eye is then compared to the distance separating the two eyes. In most species, this index is quite constant within narrow limits and is quite useful taxonomically (e.g., in *P. teleops* it is greater than three whereas in *P. americanum* it is less than one). In some species it varies so greatly that it is useless, and in others (e.g., *P. excavatum*) it varies clinally.

The relative convexity of the prosternal process is another very useful character if introduced at the proper place in a key. In a number of species (e.g., *P. americanum, P. neglectum, P. mexicanum, P. micans, P. oregonense*) this structure passes between the front coxae and is horizontal all the way to its apex; in others (e.g., *P. subcostatum, P. picilabrum*) it is just as constantly convex, with its apex deflected behind the coxae and concealed in repose. In *P. laevipes* and *P. nigratum* and several others, the form of the prosternal process is variable and hence useless as a diagnostic character.

The shape of the terminal segment of the maxillary palpi varies enough between species to be used as a supplementary character. Several of the earlier workers separated *Platydema* from other genera on the basis of the terminal segment of the maxillary palpi forming a nearly equilateral triangle. This might perhaps hold true for certain limited faunal areas, but by no means prevails throughout the genus on a worldwide basis.

The Holarctic Region is poorly represented in species of *Platydema*. In the Nearactic Region there are 19 species while Europe has only 5. The tropical regions of both hemispheres, on the other hand, abound in species. Gebien (1940) lists 40 from Africa, 77 from Asia, 54 from Central America, 55 from South America, and 28 from Papua and

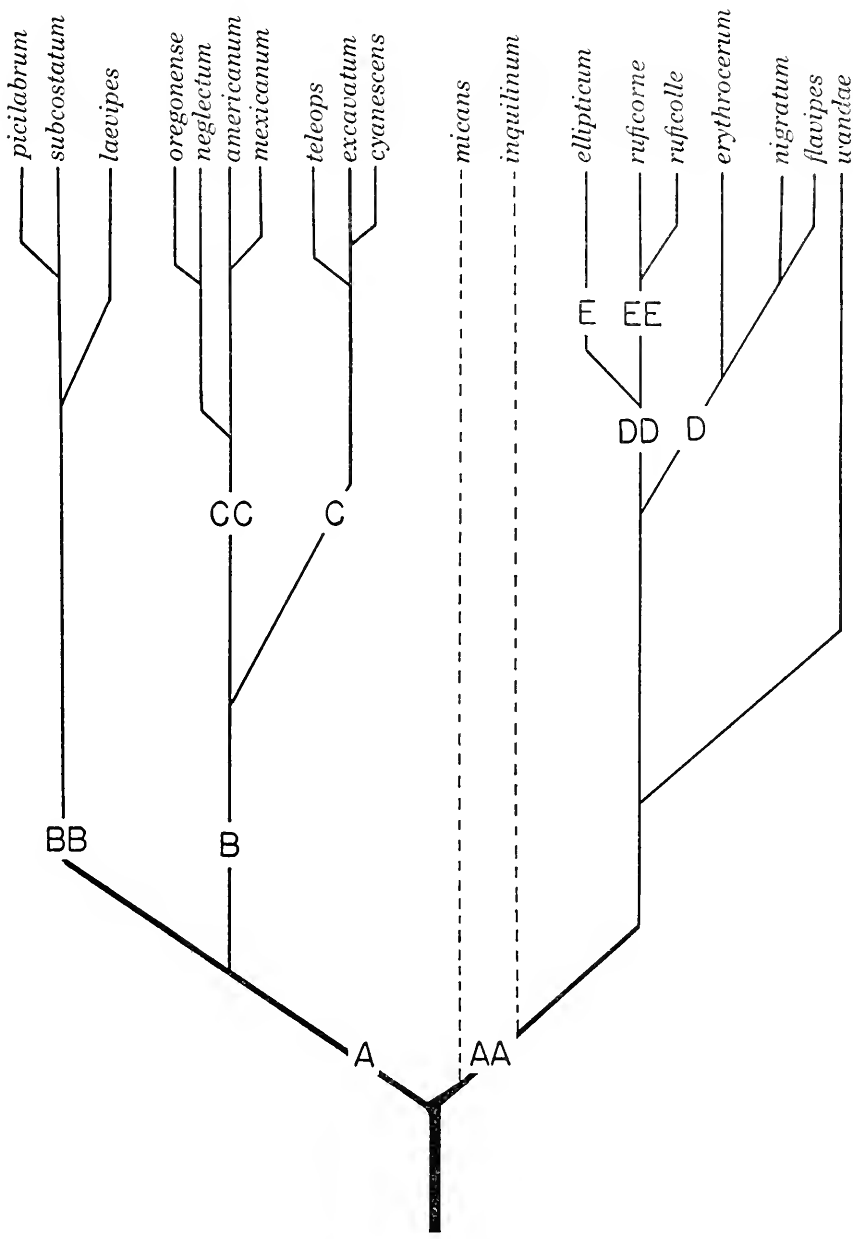

FIGURE 3.—Phylogenetic tree of the North American species of *Platydema:* A, apical sclerite composed of two parameres (see plate 4); AA, apical sclerite composed of a single piece (see plate 5); B, head with distinct longitudinal frontal impression or horned; BB, head lacking frontal impression; C, frons with horns in male, tubercles in female; CC, frons with longitudinal impression only; D, antennae bicolored; DD, antennae unicolorous; E, elytra bicolored; EE, elytra unicolorous.

Australia. Many of the Neotropical species are conspicuously patterned in bold reds and yellows. Only *P. ellipticum*, among the Nearctic forms, approaches them in this respect.

Key to North American Species of *Platydema*

1. Frons with two well-developed horns (males) or small tubercles (females) 2
   Frons with neither horns nor tubercles 5
2. Dorsal surface dull, lustreless; horns and tubercles thick and blunt. **erythrocerum** Laporte and Brullé
   Dorsal surface shining blue or black; horns slender and pointed, tubercles sharply pointed 3
3. Dorsal surface blue . . . . **cyanescens** Laporte and Brullé
   Dorsal surface black 4
4. Eyes separated ventrally by at least three times the longer axis of one eye (pl. 7, fig. 66); body narrowly oval . . . . **teleops**, new species
   Eyes separated ventrally by less than 2.5 times the longer axis of one eye; body broadly oval . . . . **excavatum** (Say)
5. Dorsal surface entirely dull and lustreless 6
   Dorsal surface glossy to strongly shining 10
6. Dorsal surface bicolored; black with oblique red band on each elytron. **ellipticum** (Fabricius)
   Dorsal surface unicolorous, dark brown or black 7
7. Antennae unicolorous from base to apex 9
   Antennae with at least basal 3 segments distinctly lighter in color than remaining segments 8
8. Entire antennal club dark; average size smaller (3.6–5.4 mm. in length). **flavipes** (Fabricius)
   Apical antennal segment entirely lighter than remaining segments; average size larger (4.6–7.8 mm. in length) . . . . . **nigratum** (Motschoulsky)
9. Pronotum indistinctly punctured; average size larger (5.5–7.8 mm. in length); known only from Arizona and New Mexico. **wandae**, new species
   Pronotum distinctly punctured, especially laterally; average size smaller (3.5–5.8 mm. in length); widespread and common in eastern North America. **ruficorne** (Sturm)
10. Each elytron with 8 complete discal striae plus at least a trace of a short basal one which more or less parallels scutellum 11
    Each elytron with 8 complete discal striae; short basal one completely absent 18
11. Prosternal process horizontal, its apex acute and prominent; frons with more or less distinct longitudinal impression between eyes; eyes viewed from beneath separated by a distance not exceeding 1.5 times the longer axis of one eye 12
    Prosternal process convex between coxae, its apex deflected (sometimes feebly prominent in *laevipes*); frons evenly convex or flat between eyes; eyes viewed from beneath separated by a distance nearly twice the longer axis of one eye (except *inquilinum*) 15
12. Pronotum roughly trapezoidal in shape (pl. 6, fig. 52), sides nearly straight, rapidly converging toward apex; apical angles right angled and prominent 13

Pronotum transverse (pl. 6, fig. 53), sides strongly arcuate, especially from middle to apex; apical angles rounded and deflected 14

13. Outer elytral striae poorly defined for about ¼ to ⅓ the length of elytra at both base and apex; punctures shallowly impressed, rather widely and irregularly spaced; color usually black; average size smaller (4.0–6.1 mm. in length) . . . . **oregonense** LeConte

Outer elytral striae well defined, strongly punctured, almost attaining base and complete at less than ¼ the length of elytra at apex; color usually brownish; average size larger (5.6–7.3 mm. in length). **neglectum**, new species

14. Sides of pronotum rather broadly expanded, somewhat crenulate with punctures conspicuously larger than those of disc; elytra broadly convex from side to side . . . . **americanum** Laporte and Brullé

Sides of pronotum narrowly if at all expanded, evenly arcuate, punctures shallowly impressed, poorly defined, subequal in size over entire pronotum; elytra feebly convex to almost flat. . . . . . . **mexicanum** Champion

15. Clypeus large, well defined, trapezoidal; eyes sunken below surface of head medially; color dark reddish brown; known only from mountains of southern Arizona . . . . **inquilinum** Linell

Clypeus moderate in size, poorly defined, transversely subquadrate; inner margins of eyes raised above surface of head medially; color usually black or at least very dark 16

16. Punctures of interstrial elytral intervals extremely minute and sparse; body brownish, feebly shining . . . . **laevipes** Haldeman

Punctures of interstrial elytral intervals large and fairly dense; body black, shining 17

17. Ventral surface of pronotum smooth to feebly rugose; average size larger (5.0–6.0 mm.), robust, shining black. **subcostatum** Laporte and Brullé

Ventral surface of pronotum coarsely and longitudinally wrinkled; size smaller (4.5–5.5 mm.), elongate, narrow, black with brassy or greenish reflections, shining . . . . **picilabrum** Melsheimer

18. Outer elytral striae poorly defined for about ¼ to ⅓ length of elytra at both base and apex . . . . **oregonense** LeConte

Outer elytral striae well defined, strongly punctured, almost attaining base and complete at less than ¼ the length of elytra at apex 19

19. Outermost elytral striae approaching adjacent striae at base, leaving unusually large humeral intervals; head densely, almost confluently, punctured . . . . **micans** Zimmerman

Outermost elytral striae normally placed; head finely and sparsely punctulate. **ruficolle** Laporte and Brullé

***Platydema excavatum* (Say)**

Plates 4 (Figs. 22, 23), 7 (Fig. 67)

Diaperis excavata Say, 1824, p. 267.
Platydema tuberculata Laporte and Brullé, 1831, p. 352.
Platydema excavata (Say), Haldeman, 1848, p. 102.
Platydema excavatum (Say), Horn, 1870, p. 381.—Champion, 1886, p. 184, pl. 8, fig. 11.
Platydema nigritum Motschoulsky, 1873, p. 470 [new synonymy].
Platydema tuberculatum (Laporte and Brullé), Chevrolat, 1878b, p. 210.
Platydema fraternum Chevrolat, 1878b, p. 210.

Platydema parvulum Casey, 1884, pp. 50, 195.—Horn, 1885, p. 111.—Casey, 1890, p. 485.

DESCRIPTION.—Body broadly oval, moderately convex, black, shining. Head of male with two prominent, parallel, cylindrical, forward-projecting horns between eyes, a deep depression between them; head of female with sharply pointed tubercles instead of horns, depression between them shallower, antennae and mouthparts reddish brown, terminal segment of maxillary palpus short, broadly triangular; eyes large, flattened dorsally, very deeply emarginate, separated ventrally by a distance varying from 1 to slightly more than 2½ times the longer axis of one eye. Pronotum trapezoidal, strongly narrowed from base to apex, sides nearly straight to slightly arcuate, basal angles rectangular, apical angles narrowly rounded, strongly deflected, marginal bead rather fine, slightly reflected, set off from rest of pronotum by a very narrow flattened area which parallels it, surface uniformly moderately, coarsely, and densely, punctured. Elytral striae feebly impressed, finely and closely punctured, intervals distinctly convex, relatively coarsely and densely punctured. Prosternal process horizontal and prominent. Ventral surface of prothorax usually thickened and convex, coarsely and densely punctured to almost smooth; metasternum punctured at least on anterior two thirds, impunctate on posterior third or less. Basal three abdominal sternites coarsely and densely, sometimes confluently, punctured, especially laterally; apical two segments finely and sparsely punctulate. Male genitalia with ventral portions of lateral lobes elongate, curved laterally, meeting the basal sclerite (pl. 4, figs. 22, 23). Measurements: length 3.4–5.8 mm.; width 2.0–3.5 mm.

REMARKS.—This is a widespread and common species and, as one might expect, subject to considerable subtle variation, particularly in sculpture and punctation. The most noteworthy variation is in the distance separating the eyes ventrally, which caused considerable consternation until a systematic study of series of specimens from various localities was undertaken. From the accumulated data, it was found that the species varies clinally in regard to this character. In the northern part of its range, from New England west to Minnesota and south to Ohio, Indiana, and Illinois, the eyes are separated by a distance subequal, on the average, to about twice the longer axis of one eye. This ratio diminishes as one proceeds southward, reaching its climax in northern South America, where the distance separating the eyes is subequal to one eye. Roughly the same ratio prevails in the West Indies.

Champion (1886) considered all of his Central American specimens to be conspecific with those from the United States. Specimens

studied from scattered localities in Mexico, Honduras, and Costa Rica fit into the clinal concept quite well.

Platydema excavatum is most likely to be confused with *P. teleops* and *P. cyanescens*. The vivid blue color of the latter species, combined with the discontinuous variation in the ventral distance between the eyes of this species and of specimens of *P. excavatum* from southern localities, should be sufficient to distinguish it.

Except for color, *P. teleops* is even more distinct than *P. cyanescens*, the distance separating the eyes ventrally reaching its height (3.2–4.2 times the longer axis of one eye) in *P. teleops*. Other characters, which unfortunately presuppose a familiarity with *P. excavatum* and hence are relative in nature, include the more narrowly elongate body, the more shining lustre, the flatter pronotum and elytral intervals, and the finer punctation of the entire dorsum.

TYPES.—*Diaperis excavata* Say. Not seen, presumably lost; type locality, "Arkansa" [sic]. *Platydema tuberculata* Laporte and Brullé. Not seen, type locality, Cuba. *P. nigritum* Motschoulsky. Not seen; specimens from Mississippi were said to compare with the type (Kelejnikova, in litt.) present in UMMZ; type locality, "Nouvelle-Orléans et à Atlanta." At the latitude of these two southern cities, any shiny black *Platydema* with horns almost certainly is *excavatum*. *P. fraternum* Chevrolat. Not seen and could not be found in Paris Museum (M. Villiers, in litt.); type locality, "Santo Domingo." Champion (1886) examined a "typical example from Santo Domingo" which he proclaimed to be "merely a small *P. excavatum*." *P. parvulum* Casey. Willets Point, Long Island, N.Y., USNM 46812. The single specimen representing this species in the Casey collection is a female, although the original discription specifies a male in which "the frontal horns are rudimentary." The description is lengthy and quite accurate, but the salient characters which are weighed most heavily in the present paper are omitted, and as a result the description could apply to either *P. excavatum* or *P. teleops*. In a note at the end of his paper Casey (1884, p. 195) states that "*Pl. parvulum* is perhaps a very small and singularly deformed specimen of *excavatum*, and the name should therefore be entered as a synonym of that species until future collecting can decide upon its true relationship."

Horn (1885), without further comment, placed it in synonymy with *P. excavatum*. In 1890, Casey (p. 485), without mention of supplemental material, elaborated further on his original description of *P. parvulum* and lists in the form of a key the differences between it and *P. excavatum*. The differences to which he alludes simply do not exist and "*parvulum*" may at best be regarded as a very small, deformed, teneral specimen of *excavatum*, a course which Casey himself was almost willing to follow in 1884. Following are notes taken

with the unique type of *P. parvulum* before me: "If anything, it is more robust than is typical of *excavatum;* the length of the antennae (weighed heavily by Casey) is not relatively any shorter than normal; the fifth and sixth interval on the left elytron are fused and obsolete on the basal fourth of their length."

SPECIMENS EXAMINED.—From the following localities, 1554:

United States: Alabama (Auburn, Mobile, Oak Grove, Oxford, Tuscaloosa). Arizona (Patagonia). Arkansas (Hope). California. Colorado. Connecticut (Litchfield, New Haven). Delaware (Dover, Glasgow). District of Columbia. Florida (Biscayne, Brooksville, Dunedin, Enterprise, Key Largo, Key West, Lake Worth, Royal Palm Park, Sanford, Sarasota, Alachua Co.). Georgia (Athens, Atlanta, Dunwoody, Savannah). Illinois (Bloomington, Riverside, Willow Springs, Saint Clair Co.). Indiana (Hovey Lake, Lafayette, South Bend, Crawford Co., Lake Co., Marion Co., Parke Co., Perry Co., Posey Co., Putnam Co., Tippecanoe Co., Vigo Co.). Iowa (Ames, Guttenberg, Iowa City, Keokuk, Milton, Mount Pleasant). Kansas (Benedict, Lawrence, Leavenworth, Lone Star, Manhattan, Medora, Onaga, Topeka, Neosho Co.). Kentucky (Frankfort, Louisville). Louisiana (Bayou Sara, Tallulah, Winnfield). Maryland (Baltimore, Berwyn, Henson Creek, Hyattsville, Plummers Island, Plum Point, Point Piney). Massachusetts (Leeds, Lowell, Sudbury). Michigan (Bath, Detroit, East Lansing, Kalamazoo Co.). Minnesota (Frontenac, Mississippi Bluff, Houston Co.) Mississippi (Leakesville, Lucedale, New Augusta, Richton). Missouri (Columbia, Creve Coeur Lake, Kansas City, Rosati, Saint Charles, Saint Louis, Warsaw). Nebraska (Fremont, King Hill, Lincoln, South Bend). New Hampshire (Farmington). New Jersey (Boonton, Clementon, Collingswood, Englewood, Fort Lee, Hopatcong, Malaga, Mount Arlington, Westville). New Mexico (La Cueva). New York (Buffalo, Dunderburg, Elbridge, Ithaca, Lockport, McLean, New York City, Olcott, Portage, Rockaway, Southold, West Point, Yaphank, Greene Co.). North Carolina (Asheville, Southern Pines, Tryon). Ohio (Athens, Bedford, Cincinnati, Columbus, Crane Hollow, Lagrange, Lancaster, Marion, Urbana, Westerville, Wooster, Allen Co. Delaware Co., Hancock Co., Holmes Co., Morrow Co., Perry Co., Scioto Co.) Oklahoma (Summerfield, Vinita, Payne Co.). Pennsylvania (Belle Vernon, Blossburg, East Berlin, Easton, Frankford, Harrisburg, Jeannette, Milford, Overbrook, Pittsburgh, Upper Darby, Wyoming, Allegheny Co.). Rhode Island (Kingston). South Carolina (Camden, Clemson, Jackson). Tennessee (East Ridge). Texas (Bastrop, Beeville, Brownsville, Bryan, Cedar Lake, College Station, Columbus, Daingerfield, Dallas, Houston, Jefferson, Kingsville, Lexington, Liberty Hill, Luling, Macdona, Mexia, New Braunfels, Round Mountain, San Felipe, Victoria, Eastland Co., Harris Co.). Virginia (Fort Monroe, Mount Vernon, Rosslyn, Nelson Co.). West Virginia (Cave Mountain, Fairmont, Huntington, Morgantown, White Sulphur Springs). Wisconsin (Baraboo, West Bend, Dane Co., Sauk Co.).

Canada: Ontario (Grimsby).

Cuba: Cienfuegos, mountains north of Imias.

Jamaica: Mandeville.

Haiti: Manneville.

Dominican Republic: Loma de la Péna.

Mexico: 32 miles south of Acaponeta, Cordoba, Jalapa, Jicaltepec, 20 miles west of Linares, Mount Colima, Puebla, Tampico, Tepic.

British Honduras: Manatee district.

Guatemala: San José.
Honduras.
Costa Rica: Hamburg Farm, San José.
British Guiana: Bartica.

Platydema teleops, new species

Plate 7 (Figs. 66, 68)

Description.—Body narrowly oval, subconvex, black, shining. Head of male with two prominent, parallel, cylindrical, forward-projecting horns between eyes, a deep depression between them; head of female with sharply pointed tubercles instead of horns, depression between them shallower, antennae and mouthparts pale reddish brown, terminal segment of maxillary palpus short, broadly triangular; eyes small, flattened dorsally, shallowly emarginate, separated ventrally by a distance greater than three times the longer axis of one eye (pl. 7, fig. 66). Pronotum trapezoidal, flattened, slightly narrowed from base to apex, sides nearly straight, basal angles rectangular, apical angles acute, marginal bead fine but prominent, not set off abruptly from rest of pronotum by a flattened area, surface coarsely and rather densely punctured, especially laterally. Elytral striae deeply and abruptly impressed, finely punctured, intervals flattened, minutely and densely punctate. Ventral surface of pronotum convex or flat, smooth to finely rugulose; prosternal process narrow, horizontal, its apex prominent; metasternum coarsely punctured; basal three abdominal sternites rather coarsely punctured, especially laterally where they usually become confluent, forming longitudinal ridges; apical two sternites with punctures fine and sparse. Male genitalia with ventral portions of lateral lobes elongate, curved laterally, meeting the basal sclerite as in *P. excavatum* (pl. 4, figs. 22, 23). Measurements: length 3.3–4.6 mm.; width 1.8–2.6 mm.

Remarks.—This species may be readily separated from *P. excavatum*, the only one with which it might be confused, by the widely separated eyes when viewed ventrally. By actual measurement, this distance varied between 3.2 and 4.4 times the longer axis of one eye. This character shows no clinal variations as exhibited by *P. excavatum*. Other useful characters are to be found in the elongate, narrowly oval body, the flatness of the elytral intervals and the shape, sculpture, and punctation of the pronotum. As a general rule, *P. teleops* has a much more polished lustre than any of its congeners. No intergrades between this species and *P. excavatum* were observed.

Almost every sizeable collection examined yielded specimens of *P. teleops* placed under the name *P. excavatum*. It is quite understandable that this species has gone unrecognized for such a long period of time. It was only after hundreds of measurements, much sorting and

resorting, and a critical evaluation of accumulated data that the true relationships were established.

TYPES.—Holotype male and allotype female, USNM 66048: Blendon Woods Metropolitan Park, Franklin Co., Ohio, May 6, 1951, NJ and ELS. Paratypes: 1 male, same as holotype (CAT); 1 female Union Township, Scioto Co., Ohio, May 26, 1951, NJ and ELS; 2 males, Scioto Co., Ohio, July 15, 1953, ELS; 1 male, Westerville, Ohio, Nov. 14, 1948, ELS; 1 female Hocking Co., Ohio, May 21, 1953, ELS; 1 male, 2 females, Hocking Co., Ohio, June 3, 1953, ELS (CAT); 3 females, Delaware Co., Ohio, May 21, DJ and JNK; 1 male, Delaware Co., Ohio, June 21, DJ and JNK; 1 female, Delaware Co., Ohio, June 25, DJ and JNK; 1 male, Delaware Co., Ohio, July 20, DJ and JNK; 1 female, Delaware Co., Ohio, June 20, 1943, DJ and JNK; 1 female, Delaware Co., Ohio, August 29, DJ and JNK; 1 male, 1 female, Scioto Co., Ohio, June 10, 1944, DJ and JNK; 1 female, Scioto Co., Ohio, June 9, 1945, DJ and JNK; 1 male, 1 female, Hocking Co., Ohio, May 20, DJ and JNK; 1 female, Hocking Co., Ohio, May 23, 1944, DJ and JNK; 1 male, Hocking Co., Ohio, May 26, 1938, DJ and JNK; 1 male, 1 female, Greene Co., Ohio, June 2, 1953, DJ and JNK (OSU); 2 males, 2 females, Ames, Iowa, Apr. 17, 1933, Ruth Madden (IoSt); 2 males, 1 female, Washington Co., Minn., May 11, 1940, W. A. Connell (Minn.); 1 male, Allegheny Co., Penn., June 17, 1894, E. A. Klages; 1 female, Allegheny Co., Penn., June 24, 1888 (CU); 1 male, 1 female, Bayfield, Wis., Wickham (MCZ); 3 males, 3 females, Stoneham, Mass., Nov. 7, F. A. Sherriff (CAS).

SPECIMENS EXAMINED.—From the following localities, 214:

United States: Colorado, Connecticut (Cornwall). District of Columbia. Illinois (Forest Park). Indiana (La Porte). Iowa (Ames, Guthrie, Iowa City). Kansas (Riley Co.). Maine (Paris). Maryland (Bladensburg, Edgewood, Little Falls, Odenton, Sparrows Point). Massachusetts (Arlington, Cambridge, Chatham, Dover, Framingham, Marion, Melrose Highlands, Stoneham, Wayland). Michigan (Detroit). Minnesota (Mouth of Snake River, Hennepin Co., Olmsted Co., Washington Co.). Missouri (Columbia, Kansas City, Willard). Nebraska (Lincoln, Nebraska City). New Hampshire (Amherst, Durham, Franconia, Hampton). New Jersey (Anglesea, Boonton, Cape May, Clementon, Estling Lake, Rahway, Rutherford). New York (Hempstead Plains, Mosholu, New York City, Patterson, Westchester, West Point, Yaphank). North Carolina (Asheville, Saluda). Ohio (Georgesville, Westerville, Delaware Co., Greene Co., Hocking Co., Scioto Co.). Pennsylvania (Frankford, Hazleton, Jeannette, Pittsburgh, State College, Allegheny Co.). South Carolina. Texas (College Station, Columbus, Kerrville, Harrison Co.). Virginia (Fort Monroe, Warrenton, Nelson Co.). West Virginia (White Sulphur Springs). Wisconsin (Bayfield, Dane Co., Polk Co., Sauk Co.).

Canada: Ontario (Ottawa, Toronto). Quebec (Aylmer).

Platydema cyanescens Laporte and Brullé

Platydema cyanescens Laporte and Brullé, 1831, p. 356.—Horn, 1870, p. 381.

Description.—Body narrowly oval, moderately convex, deep metallic blue, shining. Head of male with two prominent, parallel, cylindrical, forward-projecting horns between eyes, a deep depression between them; head of female with sharply pointed tubercles instead of horns, depression between them shallower, antennae and mouthparts reddish brown, terminal segment of maxillary palpus short, broadly triangular; eyes moderate in size, flattened dorsally, deeply emarginate anteriorly, separated ventrally by a distance of from 2.2 to 2.9 (average 2.5) times the longer axis of one eye. Pronotum trapezoidal, strongly narrowed from base to apex, sides nearly straight to slightly arcuate, basal angles rectangular, apical angles narrowly rounded, strongly deflected, marginal bead rather fine, slightly reflected, set off from rest of pronotum by a very narrow flattened area which parallels it, surface uniformly coarsely and densely punctured. Elytral striae feebly impressed, finely punctured; intervals subconvex to flat, minutely and sparsely punctulate. Prosternal process horizontal, prominent; ventral surface of pronotum thickened, flat or convex, coarsely and rugosely punctured; metasternum coarsely but sparsely punctured; basal three abdominal sternites coarsely and densely punctured, especially laterally where they are confluent, forming longitudinal ridges; terminal two sternites minutely punctulate, entire ventral surface dark brown to black with legs always a shade or two lighter. Male genitalia with ventral portions of lateral lobes elongate, curved laterally, meeting the basal sclerite as in *P. excavatum* (pl. 4, fig. 24). Measurements: length 3.4–4.6 mm.; width 1.8–2.6 mm.

Remarks.—This species shows a close affinity to both *P. excavatum* and *P. teleops*. It may be distinguished at once from either of these by the vivid blue color (sometimes tending toward greenish) of the dorsum. In the more narrowly elongate body and the flatness of the elytral intervals, it is strongly suggestive of *P. teleops*, while in the form and punctation of the pronotum and most other characters it more closely approximates *P. excavatum* in general facies.

Type.—Not seen; presumably lost; type locality, "Amerique septentrionale."

Specimens Examined.—From the following localities, 65:

United States: Alabama (Chickasaw, Mobile, Oak Grove). Florida (Biscayne, Crescent City, Dunedin, Enterprise, Fort Myers, Haulover, Lake Mary, Myakka River State Park, Ocala National Forest, Saint Petersburg, Silver Springs). Georgia (Brunswick, Spring Creek, Tybee Island). Indiana (Marion Co.). Louisiana (Covington). Mississippi (Brooklyn, Lucedale, Meridian, Richton). Tennessee (Memphis). Texas (Columbus).

Platydema americanum Laporte and Brullé

Plates 5 (Fig. 42), 6 (Fig. 53)

Platydema americana Laporte and Brullé, 1831, p. 358.
Platydema americanum Laporte and Brullé, Horn.—1870, p. 383.

Description.—Obovate, convex, reddish brown to almost black, shining. Head moderately impressed between eyes, coarsely, densely and irregularly punctured, antennae and mouthparts reddish brown, terminal segment of maxillary palpus elongate, narrowly triangular; eyes large, flattened dorsally, usually separated by a distance subequal to longer axis of one eye. Pronotum transverse, sides strongly arcuate, converging rapidly from middle toward apex, lateral margin broadly flattened, slightly reflected, a broad depression slightly behind middle, marginal bead fine, basal angles obtuse, apical angles broadly rounded, punctures of disc fine and well separated, becoming larger laterally, those of flattened portion of margins 3 or 4 times larger than those of disc. Elytral striae feebly impressed, punctures fine and deep, intervals distinctly convex, finely, sparsely, but distinctly, punctate; elytral margins rather broad, flaring, bead fine. Prosternal process narrow, flattened, horizontal; metasternum rather coarsely and densely punctured anteriorly, becoming more widely spaced posteriorly and absent on caudal fourth; abdominal punctures fine medially, becoming quite coarse and dense laterally, forming longitudinal wrinkles; apical segment uniformly finely and sparsely punctate. Male genitalia with ventral portion of lateral lobes continued backward as a single spine (pl. 4, fig. 25). No apparent external sexual dimorphism. Measurements: length 4.6–7.2 mm.; width 2.6–3.8 mm.

Remarks.—This species may be separated from all other members of the species group by the peculiar form of the pronotum. The flattened and reflected, often crenulate lateral margins with the large indentations just behind the middle, the accentuated impressions on either side of the middle of the base, plus several other surface irregularities combine to give the pronotum a very misshapen appearance.

Type.—Not seen. The description leaves but little doubt as to the identity of this species. As Laporte and Brullé point out: "La tête . . . . marquée d'un enfoncement transversal entre les yeux . . . . Le corselet . . . est bordé et un peu arrondi sur les côtes . . . . et presente deux impressions en arrière et une autre, beaucoup moins marquée, située de chaque côte, vers le milieu du bord lateral . . . . La patrie . . . . est l'Amérique septentrionale." These excerpts from the original description are sufficient to characterize the present species to the exclusion of all others. In collections I find it frequently con-

fused with *P. subcostatum,* to which it bears only the most superficial resemblance.

Specimens examined.—From the following localities, 576:

United States: Arizona (Bright Angel Camp, Catalina Mts., Chiricahua Mts., Flagstaff, Greer, Huachuca Mts., Morrison, Mount Graham, Oak Creek Canyon Palmerlee, Polino, San Francisco Mts., Santa Catalina Mts., Santa Rita Mts., White Mts., Williams). California (San Bernardino Mts., San Diego). Colorado (Cowdrey, Durango, Manitou Springs, Ouray, Waldo Canyon, Boulder Co.). Connecticut (Cornwall). Idaho (Coeur d'Alene, Moscow Mt., Priest River). Illinois. Iowa (Ames, Guttenberg, Mount Vernon). Kansas (Douglas Co.). Maine (Bethel, Monmouth, Weld). Michigan (Copper Harbor, Detroit, East Lansing, Marquette, Newberry, Saginaw, Cheboygan Co., Chippewa Co., Ottawa Co.). Minnesota (Cedar Creek Bog, Lake Itasca, Mississippi Bluff, Plummer, Olmsted Co.). Missouri (Saint Louis). Montana (Bear Paw Mt., Cimbia Falls, Potomac). Nebraska (Pine Ridge, Custer Co.). Nevada (Dixie National Forest). New Hampshire (Claremont). New Jersey (Englewood, Bergen Co.). New Mexico (Albuquerque, Cloudcroft, Jemez Mts., Las Vegas, Manzano, Santa Fe, Tajique). New York (Allegany State Park, Buffalo, Danby, Elbridge, Hamburg, Ithaca, Lancaster, New York City, Olcott, Peru, West Point, Greene Co.). North Carolina (Black Mts.). Ohio (North Olmsted, Wooster, Franklin Co.). Pennsylvania (Hummelstown, Jeannette, Pittsburgh, State College, Allegheny Co., Tioga Co.). South Dakota (Hill City, Spearfish). Texas (Davis Mts., El Paso). Utah (Bryce Canyon, Farmington, Parowan Canyon, Provo, Utah Co.). Washington (Palouse). Wisconsin (Bayfield, West Bend). Wyoming.

Canada: Alberta (Edmonton). British Columbia (Foulder, Merritt, Trinity Valley). Manitoba (Aweme). Ontario (Bells Corners, Bruce, Grimsby, Guelph, Manitoulin Island, Muskoka, Strathroy, Toronto, Turkey Point, Hastings Co., Prince Edward Co.). Quebec (Aylmer, Fort Coulonge, Duparquet, Laniel, Montreal).

Platydema mexicanum Champion

Plates 4 (Fig. 26), 7 (Fig. 69)

Platydema mexicanum Champion, 1886, p. 187, tab. 8, fig. 12.

Description.—Body obovate, slightly depressed medially, light reddish brown to almost black, feebly shining. Head shallowly impressed between eyes, moderately coarsely and densely punctured, antennae and mouthparts reddish brown, terminal segment of maxillary palpus elongate, narrowly triangular; eyes large, flattened dorsally, separated ventrally by a distance subequal to longer axis of one eye. Pronotum transverse, sides evenly arcuate, basal angles obtuse apical angles broadly rounded, lateral marginal bead thickened and reflected, punctures fine, shallowly impressed, rather sparsely and irregularly distributed, becoming somewhat larger baso-laterally in some specimens. Elytral striae feebly impressed, punctures fine, shallow; intervals almost flat, very minutely and sparsely punctured, lateral margins of elytra rather broad, flaring, marginal bead fine. Prosternal process narrow, horizontal; metasternum finely and sparsely punctate, punctures absent on caudal portion; abdomen rather coarsely

but sparsely punctured forming longitudinal wrinkles laterally, except two apical segments on which punctures are very fine and more closely spaced. Male genitalia with ventral portion of lateral lobes continued backward as a single spine (pl. 4, fig. 26). No apparent external sexual dimorphism. Measurements: length 5.7–7.4 mm.; width 3.0–3.8 mm.

Remarks.—This species is very closely allied to *P. americanum* and at first appeared to represent just a slightly aberrant form of the latter species. Champion was apparently unfamiliar with *P. americanum* except from its description, but he correctly inferred the close affinity between it and the present species, a tribute to the accurate descriptions of Laporte and Brullé.

P. mexicanum may be distinguished from *P. americanum* by the relative flatness and feebly shining lustre of the dorsum, the much less conspicuous punctures on the head, pronotum, and elytra, and the form and punctation of the lateral margins of the pronotum. All of the foregoing characters, relative in nature, give, when taken together, a facies totally unlike that of any other member of this species group.

Type: BMNH: Jalapa, Mexico (Höge). Lectotype selected from Champion's cotypic series; sex undertermined. This is the specimen figured by Champion. It is in excellent condition, but because of its historical value and the manner in which it is mounted, it was deemed inadvisable to attempt a dissection.

Specimens examined.—From the following localities, 84:

United States: Arizona (Chiricahua Mts., Flagstaff, Palmerlee, Santa Catalina Mts., White Mts.). New Mexico (Las Vegas, Porvenir).

Mexico: Ciudad in Durango, Durango, Jalapa, Juan Manuel El Salto, Mount Colima.

Platydema neglectum, new species

Description.—Body obovate, strongly convex, light reddish brown to almost black, strongly shining. Head prominently impressed between eyes, coarsely and densely punctured, antennae and mouthparts reddish brown, apical antennal segment sometimes sharply pointed (pl. 6, fig. 54); terminal segment of maxillary palpus elongate, narrowly triangular; eyes large, flattened dorsally, separated ventrally by a distance usually subequal to longer axis of one eye. Pronotum trapezoidal, sides usually almost straight, narrowly margined, strongly reflected, bead very fine, basal angles nearly square, apical angles obtuse, narrowly rounded, surface coarsely but not densely punctured, lateral punctures slightly larger than those of disc. Elytral striae moderately strongly impressed, punctures rather coarse and deep, intervals convex, rather coarsely and densely punctate. Pro-

sternum prominent, convex, horizontal, its apex bluntly rounded, anterior portion (in front of forecoxae) strongly carinate; metasternum finely and densely punctate, except caudo-lateral portion; abdomen coarsely and densely punctured, forming longitudinal wrinkles laterally except two apical segments where punctures are fine and sparse, not forming wrinkles laterally. Male genitalia with ventral portion of lateral lobes continued backward as a single spine incomplete at apex (pl. 4, fig. 28). No apparent external sexual dimorphism. Measurements: length 5.6–7.3 mm.; width 3.1–4.2 mm.

REMARKS.—I encountered in a number of collections occasional individuals and short series of specimens which at first I thought represented extreme variations of *P. americanum.* Many had been identified by various workers as *P. americanum* and *P. oregonense.* When these were segregated, critically examined, and plotted distributionally, it became evident that I was dealing with a strikingly different form, which I regard as a distinct species. Its resemblance to both of the above mentioned species cannot be denied; however, it resembles neither of them entirely, being more or less intermediate in regard to several characters.

It may be distinguished from *P. oregonense* by its more parallel elytral margins and the relatively complete outermost elytral striae, the more conspicuously punctured elytral intervals, the more shallowly impressed frontal depression, and the somewhat larger average size.

From *P. americanum* it may be separated by the trapezoidal pronotum with its straight or very feebly arcuate, narrowly expanded, and less strongly reflected, lateral margins, which almost always lack even traces of the broad impression on each side behind the middle so characteristic of *P. americanum.*

The genitalia suggest a closer affinity with *P. americanum* than with *P. oregonense*, but external characters point first toward one and then the other. The head and thorax strikingly resemble those of *P. oregonense*, while the form and sculpture of the elytra are equally as strongly suggestive of *P. americanum.*

The distance separating the eyes ranges from almost twice to less than the longer axis of one eye and is unreliable as a taxonomic character.

The peculiar prolongation of the apical antennal segment mentioned above is most perplexing. In a series of 105 specimens from Modoc County, Calif., 22 show an extreme awl-shaped segment (pl. 6, fig. 54), 33 show a tendency toward this modification but developed to a lesser degree, 25 show merely a pointed apical segment, while 29 show a rounded type which I consider more or less typical of a member of this genus.

In the other 142 specimens from numerous localities which I examined, only one specimen (North Bend, British Columbia) bears the awl-shaped segment. One can, therefore, place no reliance on the form of this segment. Evidently the Modoc County series represents an isolated population; I have seen nothing approaching this antennal modification in any other members of *Platydema*.

Types.—Holotype male and allotype female, USNM 66049; Modco County, Calif., 15 miles north of Alturas, June 16, 1954, R. O. Shuster. Paratypes: same data as holotype placed in following collections—2 each in BMNH, MCZ, CU, OSU, CAT; 90 in UCal.

Specimens examined.—From the following localities, 264:

United States: California (15 miles north of Alturas, Angora Lake, Auburn, Boonville, Carmel, Carter Mountain, Chester, Davis, Facht, Fallen Leaf, Fish Camp, Hat Creek, Idyllwild, Lassen National Park, Lone Pine, Los Angeles, Mammoth, McCloud, Meadow Valley, Mokelumne Hill, Monterey, Nichols Mills, Old Station, Placerville, Pohono Trail, Round Meadow Giant Forest, San Jacinto Mts., Sierra National Forest, Soda Springs, Viola, Weed, Yosemite, Humboldt Co., Madera Co., Mariposa Co., Tulare Co.). Idaho (Coeur d'Alene, Centerville, Moscow, Riggins, Robinson Lake). Montana (Kalispell, Sula). Nevada (Reno, Washoe Co.). Oregon (Blue Mts., Cliff Ridge, Dilley, Hilgard, Hood River, The Dalles). Utah (Logan Canyon). Washington (Fort Lewis, Pullman. Tenino).

Canada: British Columbia (North Bend).

Platydema oregonense LeConte

Plate 4 (Fig. 27)

Platydema oregonense LeConte, 1857, p. 51.—Horn, 1870, p. 383.

Description.—Body broadly ovate, strongly convex, dark reddish brown to almost black, moderately shining. Head deeply impressed between eyes, coarsely but not densely punctured, antennae and mouthparts reddish brown, terminal segment of maxillary palpus elongate, narrowly triangular; eyes rather small, flattened dorsally, separated ventrally by a distance subequal to 1.5–2.0 times the longer axis of one eye. Pronotum trapezoidal, evenly convex from side to side, sides almost straight, basal angles rectangular, apical angles obtusely rounded, lateral marginal bead fine, narrowed basally and apically, slightly wider behind middle, surface finely and sparsely punctured on disc, punctures becoming larger and more closely spaced laterally. Elytral striae feebly impressed, finely punctured, outermost stria on each side conspicuously abbreviated at both ends, punctures closely spaced medially, becoming increasingly farther apart and disappearing altogether at a considerable but variable distance from both base and apex; intervals subconvex, minutely and sparsely punctate; lateral margins of elytra undulated, marginal bead fine, feebly reflected. Prosternal process narrow anterior to

front coxae, becoming gradually broader to just behind coxae, then rapidly tapering to a point apically, horizontal, and prominent. Metasternum coarsely and sparsely punctured anteriorly, a large crescent-shaped area along caudal margin devoid of punctures. First four abdominal segments uniformly coarsely and densely punctured, forming longitudinal wrinkles laterally, apical two segments finely and sparsely punctate. Male genitalia with ventral portion of lateral lobes continued backward as a single short spine (pl. 4, fig. 27). No apparent external sexual dimorphism. Measurements: length 4.0–6.1 mm.; width 2.3–3.4 mm.

Remarks.—This species is remarkably constant in appearance and may readily be distinguished from its congeners by the broadly ovate form, the deeply impressed head, the very narrow and slightly undulated lateral elytral margins and the abbreviated outermost elytral striae.

Type.—MCZ 4692; type locality, Oregon. The specimen is in very poor condition but quite recognizable.

Specimens examined.—From the following localities, 682:

United States: California (Ahwahnee, Auburn, Bartlett Springs, Bass Lake, Beaumont, Biledo Meadow, Blocksburg, Bucks Lake, Carmel, Cazadero, Chester, Chiquito Creek, Cole, Colorado Desert, Colton, Dunsmuir, Eagle Park Meadows, Facht, Gold Lake, Huckleberry Meadow, Huntington Lake, Idyllwild, Indio, Kaweah, Kyburz, Laguna Beach, Lagunitas, Lake Arrowhead, Lake Tahoe, Little Yosemite, Los Gatos, Lyons Dam, Manzanita Lake, Mather, McCloud, Meadow Valley, Millwood, Mokelumne River, Mountain Springs, North Fork, Oakland, Ojai, Old Station, Pacific Slope, Palo Alto, Palomar, Pasadena, Phillips Station, Riverside, Round Meadow Giant Forest, San Berardino, San Diego, San Jacinto Mts., San Mateo, Santa Cruz Mts., Sequoia National Park, Sierra National Forest, Soda Springs, Stockton, Strawberry Valley, Sugar Pine, Summit Lake, Tallac, Tanbark Flat, Tenaya Canyon, Truckee, Viola, Walnut Creek, White Water, Wolverton, Wrights Lake, Yosemite National Park, Alpine Co., El Dorado Co., Los Angeles Co., Mariposa Co., Placer Co., Santa Clara Co., Siskiyou Co., Sonoma Co., Trinity Co., Tulare Co.). Idaho (Pierce, Priest River, Wallace). Oregon (Ashland, Astoria, Corvallis, Forest Grove, Hood River, Medford, Portland, Suttle Lake, Upper Klamath Lake). Washington (Baring, Easton, North Bend, Tenino, Wenatchee).

Canada: British Columbia (Creston, Lillooet District, Mission City, Pender Harbor, Steelhead, Trinity Valley, Vancouver).

Platydema laevipes Haldeman

Plate 4 (Fig. 29)

Platydema laevipes Haldeman, 1848, p. 101.—Horn, 1870, p. 383.—Blatchley, 1910, p. 1264.
Platydema crenatum LeConte, 1878, p. 422 [new synonymy].

Description.—Body elongate oval, strongly convex, dark brown to blackish, feebly shining. Head convex between eyes, coarsely and densely punctured, usually a few large, widely separated punctures

just above clypeus, antennae and mouthparts reddish brown, terminal segment of maxillary palpus short, broadly triangular; eyes small, convex dorsally, inner margins raised well above plane of head, separated ventrally by a distance subequal to twice the longer axis of one eye. Pronotum transverse, sides rather strongly arcuate, parallel at least behind middle, basal angles obtusely rectangular, apical angles broadly rounded, lateral marginal bead fine, margins slightly and uniformly flattened from base to apex, often feebly reflected, surface finely and sparsely punctured on disc with larger punctures in lateral depression. Elytral striae shallowly but distinctly impressed, punctures coarse and well separated, intervals more or less strongly convex, minutely and sparsely punctate. Prosternal process broad and flat between coxae, its apex usually prominent but occasionally deflected and obtuse. Ventral surface of pronotum usually impunctate but frequently with feeble longitudinal ridges. Metasternum coarsely but sparsely punctured; abdominal sternites coarsely and densely punctured except apical two which have minute, widely separated punctures. Male genitalia with ventral portions of lateral lobes continued backward as two short spines (pl. 4, fig. 29). No apparent sexual dimorphism. Measurements: length 4.4—6.3mm.; width 2.4—3.5 mm.

Remarks.—This species closely approaches *P. subcostatum* in general appearance and understandably is often mistaken for it in collections. The majority of specimens may be separated from *P. subcostatum* at once by the erect prosternal process; however, a number have been observed in which the apex of this structure is concealed in such a way that it would be impossible to identify them by this character alone, without relaxing them and pushing back the pronotum in order to raise the prosternum from its cleft in the mesosternum. A number of other constant but unfortunately relative characters render it quite distinct from *P. subcostatum*. The duller lustre of the dorsum, the shape of the pronotum and the deeper, more coarsely punctured elytral striae are useful taxonomic characters, although difficult to describe. The elytral intervals of *P. laevipes* are always distinctly convex and obscurely punctured. The male genitalia are of little or no value in diagnosing this species.

Platydema crenatum LeConte is but an extreme variant of the present species, in which the punctures of the elytral striae are slightly coarser and the intervals more convex.

Type.—MCZ 8371. The specimen bearing the type label is spotted with mud or other detritus, but is otherwise in good condition and quite recognizable. It bears a pink "Middle States" label. Other material under this name in the LeConte collection (MCZ) where the type now reposes includes two additional specimens with the pink

"Middle States" label, presumably from the original Haldeman series, two labeled "Texas," and one labeled "Va."

The type of *P. crenatum* LeConte (MCZ 4693) is a unique in the cabinet of LeConte. It was taken at Haulover, Fla., on March 1.

Specimens examined.—From the following localities, 154:

United States: Alabama (Mobile, Monroeville). Arkansas (Hope, Ouachita Mts., Lawrence Co.). District of Columbia. Florida (Crescent City, Fernandina Beach, Gainesville, Haulover, Orlando, Citrus Co.). Georgia (Adairsville, Atlanta, Clayton, Dunwoody). Indiana (Crawford Co., Posey Co., Vigo Co.). Iowa (Washington Co.). Kansas (Princeton). Louisiana (Opelousas, Winnfield). Maryland (Baltimore, Bladensburg, Odenton, Sparrows Point). Massachusetts (Sherborn). Mississippi (Avera, Leakesville, Lucedale, New Augusta, State Line). Missouri (Columbia, Creve Coeur, Hayden, New Hartford, Pike Co.). New Jersey (Chadwicks, Ocean City, Vineland). New York (Rockaway). North Carolina (Asheville, Tryon). Ohio. Pennsylvania. South Carolina (Camden, Florence). Texas (College Station, Columbus, Daingerfield, Dallas, Davis Mts., Deweyville, Green Valley, Handley, Houston, Victoria, Burleson Co., Burnet Co., Jackson Co.). Wisconsin (Dane Co.).

Platydema subcostatum Laporte and Brullé

Plates 2 (Fig. 11), 4 (Fig. 31)

Platydema subcostata Laporte and Brullé, 1831, p. 362.
Platydema subcostatum Laporte and Brullé.—Horn, 1870, p. 384.—Blatchley, 1910, p. 1264.
Platydema clypeatum Haldeman, 1848, p. 102.
Platydema oblongulum Motschoulsky, 1873, p. 470 [new synonymy].

Description.—Body elongate oval, strongly convex, dark brown to almost black, shining. Head uniformly convex between eyes, coarsely and densely punctured, usually a few large, widely separated punctures just above clypeus, antennae and mouthparts reddish brown, terminal segment of maxillary palpus short, broadly triangular; eyes moderate in size, convex dorsally, inner margin raised well above plane of head, separated ventrally by a distance equal to from 2 to 3 times the longer axis of one eye. Pronotum transverse, sides feebly arcuate, almost parallel, an elongate impression slightly behind middle tapering toward base and apex, basal angles rectangular, apical angles very broadly rounded, lateral marginal bead fine, surface finely and sparsely, rather uniformly punctured with a few well-separated larger punctures in flattened lateral areas. Elytral striae feebly impressed, finely punctured, intervals flat to subconvex, usually finely and rather densely punctured; elytral margins feebly arcuate, nearly parallel, bead fine, slightly reflected. Prosternal process broad and flat between coxae, its apex deflected, obtuse, not prominent. Ventral surface of pronotum variously sculptured, smooth to rugose, never with strong longitudinal ridges, metasternum and basal three abdominal sternites coarsely and densely punctured;

apical two abdominal sternites minutely and sparsely punctate. Male genitalia with ventral portions of lateral lobes continued backward as two short spines; dorsal portions fused, forming a broad arc posteriorly, but with visible remnants of a much narrower fusion (pl. 4, fig. 31). No apparent external sexual dimorphism. Measurements: length 5.0–7.9 mm.; width 2.7–4.2 mm.

REMARKS.—This species, the largest in northeastern North America, is closely related to both *P. picilabrum* and *P. laevipes*. This conclusion is supported by a study of the male genitalia in which the ventral portions of the lateral lobes are continued backward as two spines and the dorsal portions are fused much farther posteriorly, forming an arcuate bridge which more or less obscures their paired nature (pl. 4, fig. 31).

The larger size of *P. subcostatum*, its broader form, uniform dark coloration without bluish or greenish reflections, the raised inner margins of the eyes, and the lack of coarse longitudinal ridges on the underside of the pronotum, should readily distinguish the majority of specimens from *P. picilabrum*. An excellent character is to be found in the dorsal portions of the lateral lobes of the male genitalia. In *P. picilabrum* these lobes are completely fused, forming a strong, nearly straight bridge, while in *P. subcostatum*, the traces of former lines of fusion are quite apparent.

P. subcostatum may be distinguished from *P. laevipes* by the shining lustre of the dorsum, the consistently deflexed apex of the prosternal process, the flatter, more strongly punctured elytral intervals, the more feebly impressed and more finely punctured elytral striae, and the very narrowly margined pronotum. There are no clearcut differences in the male genitalia. In *P. subcostatum*, the acute dorsal groove of the basal sclerite and the struts in repose protruding substantially beyond the base of the sclerite appear to be constant and diagnostic characters. In addition, the relatively larger size of the entire aedeagus is a useful criterion.

TYPE.—Not seen; type locality listed as Philadelphia. The type of *P. clypeatum* Haldeman (MCZ 8368) is a typical specimen of *P. subcostatum* and was placed under that name by LeConte in his collection. It bears a "Middle States" label. Ohio specimens correspond to the types of *P. oblongulum* in UMMZ (Kelejnikova, in litt.). Type locality, "Florida."

SPECIMENS EXAMINED.—From the following localities, 763:

United States: Alabama (Barton, Selma, Tuscaloosa). Arkansas (Hot Springs). Connecticut (Cornwall, Hamden, New Haven). Delaware (Bombay Hook, Glasgow, Newark, Seaford). District of Columbia. Florida (Brooksville, Cresent City, Enterprise, Suwannee River). Georgia (Athens, Atlanta, Clayton, Cornelia, Dunwoody, Savannah, Tybee Island). Illinois (Forest

Park, McHenry, Quincy, Willow Springs, Saint Clair Co.). Indiana (Lafayette, Clark Co., Fountain Co., Jackson Co., Jennings Co., Lake Co., Lawrence Co., Marion Co., Marshall Co., Perry Co., Putnam Co., Starke Co., Vigo Co., Warren Co.). Iowa (Ames, Gladbrook, Iowa City, Lehigh, Shenandoah, Washington Co.). Kansas (Argentine, Douglas Co.). Kentucky (Frankfort, Louisville, Edmonson Co.). Louisiana (Covington). Maryland (Baltimore, Bladensburg, Glen Echo, Odenton, Plummers Island, Riverdale, Somerset, Tacoma Park). Massachusetts (Arlington, Beach Bluff, Boston, Cambridge, Dorchester, Lowell, Marion, Nahant, Natick, Northfield, Sherborn, Springfield, Swampscott, Tyngsboro, Woburn). Michigan (Detroit, East Lansing, Galesburg, George Reservation, Inkster, Pittsford, Port Huron). Minnesota (Eitzen, John Latsch State Park, Lake Pepin, Mississippi Bluff). Mississippi (Columbia, Lucedale, New Augusta, State Line). Missouri (Hayden, New Hartford, Saint Louis). New Hampshire (Farmington). New Jersey (Anglesea, Atsion, Boonton, Camden, Chadwicks, Clementon, Englewood Cliffs, Fort Lee, Hemlock Falls, Highlands, Hopatcong, Lakewood, Malaga, Merchantville, Orange, Phillipsburg, Riverton, Taunton Lake, Tenafly, Vineland, Wenonah, Woodbury). New York (Aqueduct, Brooklyn, Brownville, Cedarhurst, Cold Spring Harbor, Flatbush, Flushing, Forest Park, Ithaca, Kew Gardens, McLean, Montauk, New York City, Olcott, Peekskill, Riverhead, Rockaway Beach, Sunken Meadow State Park, Wading River, West Farms, West Point, Wyandanch, Yaphank). North Carolina (Asheville, Lake Toxaway, Mount Sterling, New River, Southern Pines, Tryon, Wilkesboro). Ohio (Akron, Athens, Cincinnati, Columbus, Georgesville, Allen Co., Delware Co., Fairfield Co., Hocking Co., Licking Co., Scioto Co.). Pennsylvania (Allegheny, Belle Vernon, Bethlehem, Bustleton, Castle Rock, Cresent Hill, Doyle, Easton, Frankford, Harrisburg, Jeannette, Overbrook, Philadelphia, Pittsburgh, State College, Tinicum Island, Villanova, West View, Delaware Co., Washington Co., York Co.). Rhode Island (Watch Hill). South Carolina (Clemson College). Tennessee (Deer Lodge, Elmwood). Texas (Deweyville, Liberty). Virgina (Fairfax, Falls Church, Fredericksburg, Great Falls, Pennington Gap, Vienna, Lee Co., Nelson Co.). West Virginia (Berkeley Springs, Cheat Mts., Fairmont, Harpers Ferry, Morgantown). Wisconsin (Dane Co.).

Canada: Ontario (Grimsby).

Platydema picilabrum Melsheimer

PLATE 4 (FIG. 30)

Platydema picilabrum Melsheimer, 1846, p. 62.—Horn, 1870, p. 384.—Blatchley, 1910, p. 1264.

DESCRIPTION.—Body elongate oval, strongly convex, dark brown to blackish with bluish, greenish, or coppery reflections, shining. Head convex between eyes, rather uniformly coarsely and densely punctured, antennae and mouthparts reddish brown, terminal segment of maxillary palpus short, broadly triangular; eyes small, convex dorsally but with inner margin not conspicuously raised above plane of head, separated ventrally by a distance equal to from 1½ to 3 times the longer axis of one eye. Pronotum transverse, sides feebly arcuate, almost parallel, basal angles obtusely rectilinear, apical angles very broadly rounded, lateral marginal bead fine, surface rather uniformly coarsely and densely punctured. Elytral striae strongly impressed,

finely punctured; intervals subconvex, finely and densely punctured; elytral margins feebly arcuate, nearly parallel, bead fine, slightly reflected. Prosternal process with parallel sides, its apex deflected and obtuse, not prominent. Ventral surface of pronotum with strong longitudinal ridges instead of punctures, entire ventral surface coarsely and densely punctured except apical two abdominal sternites where punctures are fine and sparse. Male genitalia with ventral portions of lateral lobes continued backward as two short spines; dorsal portions fused basally to form a broad shallow arc without a trace of former lines of fusion (pl. 4, fig. 30). No apparent external sexual dimorphism. Measurements: length 4.2–5.7 mm.; width 2.2–2.6 mm.

REMARKS.—This species may be readily separated from *P. subcostatum*, its nearest ally, by its smaller, narrower form, the metallic coppery, bluish or greenish reflections of the dorsum, and the presence of coarse longitudinal ridges on the ventral side of the pronotum. The male genitalia are quite distinctive in that the lateral lobes are fused basally, thus obscuring their paired condition.

TYPE.—In the Melsheimer collection (MCZ) there are two specimens of the present species, both without data. One of these is hereby designated as lectotype but as yet has not been assigned an accession number. Type locality, Pennsylvania.

SPECIMENS EXAMINED.—From the following localities, 156:

United States. Alabama (Barton, Mobile). Arkansas. District of Columbia. Florida (Crescent City, Enterprise). Georgia (Atlanta, Cornelia, Dunwoody). Illinois (Chicago, Downers Grove). Indiana (Posey Co., Putnam Co., Vigo Co.). Kansas. Kentucky (Frankfort). Louisiana (Covington). Maryland. Massachusetts (Amherst, Framingham, Lowell, Natick, Sherborn, Tyngsboro, Wayland). Michigan (Detroit). Mississippi (Lucedale, State Line). Missouri (New Hartford, Saint Charles). New Jersey (Anglesea, Fort Lee, Paterson, Wenonah). New York (Bergen Beach, West Point). North Carolina (Murphy, Saluda, Tryon). Ohio (Athens, Delaware Co., Scioto Co.). Pennsylvania (Easton, Harrisburg, Jeannette, Pittsburgh, State College, Allegheny Co., Washington Co., York Co.). South Carolina (Camden). Texas (Houston). Virginia (Mount Vernon). West Virginia (Morgantown, White Sulphur Springs).

Platydema ruficorne (Sturm)

PLATE 5 (FIGS. 40, 41)

Diaperis ruficornis Sturm, 1826, p. 69, tab. 3, fig. 21.

Platydema rufiventris Laporte and Brullé, 1831, p. 378.—Haldeman, 1848, p. 101.

Neomida ruficornis (Sturm).—Sturm, 1843, p. 155.

Neomida rufa Melsheimer, 1846, p. 62.

Platydema analis Haldeman, 1848, p. 101.

Platydema ruficorne (Sturm).—Horn, 1870, p. 382; 1885, p. 111.—Blatchley, 1910, p. 1263.—Cotton, 1941, p. 9, fig. 15.—Back and Cotton, 1953, p. 31, fig. 43.

Platydema opaculum Casey, 1884, p. 51; 1890, p. 485.

Description.—Short, broadly oval, moderately convex, brownish black to black, often with purplish cast, dull in lustre. Head evenly arcuate in front, anterior margin reddish, flattened or feebly convex between eyes, epistomal suture well defined, surface uniformly coarsely and densely punctured; eyes small, widely separated both above and below, convex, broadly and deeply emarginate anteriorly, dorsal anterior margin deeply set in head, sharply elevated behind; separated ventrally by a distance subequal to about two (1.8–2.6) times the longer axis of one eye; mouthparts light reddish brown, terminal segment of maxillary palpus broadly triangular with distal angle prolonged; antennae uniformly pale reddish brown from base to apex. Pronotum twice as broad as long, strongly narrowed from base to apex, sides strongly arcuate, narrowly margined, bead fine and slightly reflected, basal angles rectangular, apical angles broadly rounded, disc finely but distinctly punctured, lateral punctures larger, subequal to those of head. Elytra convex, sides strongly rounded, narrowly margined with distinct bead, striae feebly or not at all impressed, finely and closely punctured, intervals flat to rather strongly convex, impunctate, rarely with a few minute, widely scattered punctures. Prosternal process variable, usually horizontal with apex prominent, sometimes feebly convex or convex with apex secondarily reflected, margined between coxae. Ventral surface of pronotum concave, usually coarsely and densely punctured, sometimes smooth, edges very thin; metasternum with coarse, widely spaced punctures; abdominal sternites coarsely and densely punctured, each with at least a faint lateral depression, always especially pronounced on fourth sternite; entire ventral surface including epipleura reddish brown, except apical sternite which is often black. Male aedeagus with apical sclerite flat, blade like, about one-fifth longer than basal sclerite; a strong constriction between apical and basal sclerites (pl. 5, figs. 40, 41). Measurements: length 3.5–5.8 mm.; width 2.0–3.4 mm.

Remarks.—This is probably the most frequently encountered and abundant species of *Platydema* inhabiting eastern North America, excluding the New England states and the northern parts of Minnesota, Wisconsin, and Michigan. It is difficult to characterize because there is nothing particularly distinctive about it. Its salient features, consisting of a broadly oval form, dull and velvety dorsal surface, coarsely and densely punctured head and pronotum, and uniformly pale antennae, separate it from its congeners, with the possible exceptions of *P. ruficolle* and *P. wandae*. Characters which will separate it from these two are discussed separately under each of the latter. In collections it is frequently confused with both *P. nigratum* and *P. flavipes*, but these readily may be distinguished by means of

their bicolored antennae. The male genitalia indicate a close relationship with both *P. ruficolle* and *P. flavipes*.

Numerous deviations in form have been encountered, making it necessary to preface a number of statements in the composite description with the word "usually." All of these deviations were carefully considered and were found to belong to one rather variable species. Several of the synonyms were based on extreme variants of of the typical form; indeed, it is surprising that it was described only under five different names. Prominent among these variations is the elongate form which approaches that of *P. flavipes*. The relative convexity of the elytral intervals and the position of the apex of the prosternal process fluctuate considerably, even among individuals of a single population. The dorsal surface lustre is constant. Specimens appearing slightly glossy reveal their true lustre when touched lightly with a brush dipped in ether.

P. ruficorne has entered the economic literature under the common name "red-horned grain beetle" (Back and Cotton, 1953). It has been reported commonly from shelled corn in Missouri, Iowa, and Illinois. From all indications the beetle is particularly attracted to grain having a high moisture content which makes it damp and moldy; it is doubtful that it ever attacks sound grain. Normally it is found under the bark of dead trees and in fleshy fungi. On several occasions it has been reported coming to lights.

TYPES.—*Diaperis ruficornis* Sturm; not seen; type locality, "Amer. bor." *Platydema rufiventris* Laporte and Brullé; not seen; type locality, "Philadelphie." *Neomida rufa* Melsheimer; not seen; missing from Melsheimer collection (MCZ) (E. A. Chapin, in litt.); type locality, Pennsylvania. Horn (1870) states that it is "but an immature specimen of *ruficorne*." *Platydema analis* Haldeman: MCZ 8369; bears a pink "Middle States" label. This is a very typical specimen of *ruficorne* as defined herein. Both hindlegs and both antennae are gone and the pin is badly corroded. *Platydema opaculum* Casey: USNM 46813; bears a "Penn." label but said by Casey to be from near Philadelphia. A year after its description, Horn (1885) placed it into synonymy with *P. ruficorne*, calling it var. *anale* Haldeman. Casey himself (1890) somewhat reluctantly concurred, with the comment that it "appears to be a small and rather abnormal specimen of *ruficornis* Sturm . . . " and placed it under that name in his collection. It falls well within the range of variation, including size (3.9 mm. long), as described above. *Platydema pallens* Laporte and Brullé (1831, p. 377) is sometimes included (Gebien, 1911, 1940; Leng, 1920), as a synonym of the present species. The original description could fit any number of species including *P. ruficorne*. The measurements given (3 lines long, 2 lines

wide) are well beyond the range of size encountered in this study and the locality ("bords du Maroni, dans la Guiane francaise") is, of course, widely separated from the known limits of distribution for *P. ruficorne*. It almost certainly represents some other species.

SPECIMENS EXAMINED.—From the following localities, 1793:

United States: Alabama (Auburn, Bessemer, Cheaha State Park, Marion, Mobile, Montgomery, Oxford, Peterman, Riderwood, Tuscaloosa, Wadley). Arkansas (Carthage, Cove, Fouke, Hope, Lawrence Co., Prairie Co., Washington Co.). Colorado (Denver). Connecticut (Hamden). Delaware (Glasgow, Newark). District of Columbia. Florida (Big Pine, Brooksville, Citra, Dunedin, Dunseith, East Palatka, Elfers, Enterprise, Fruitland Park, Gainesville, Jacksonville, Lakeland, Lake Worth, Monticello, Orange, Ormond Beach, Paradise Key, Pine, Punta Gorda, Saint Augustine, Sanford, Sarasota, Tampa, Winter Park, Duval Co., Jackson Co., Leon Co., Marion Co.). Georgia (Albany, Arlington, Athens, Atlanta, Baconton, Cartersville, Clayton, Cornelia, Dunwoody, Griffin, Kings Island, Milner, Norwood, Savannah, Stone Mountain, Thomasville, Thomson, Warrenton). Illinois (Bloomington, Camp Drake, Fort Sheridan, Homer, Quincy, Scott Field, Urbana, Willow Springs, Piatt Co.). Indiana (Hessville, Hovey Lake, Lafayette, La Porte, Lebanon, Cass Co., Crawford Co., Harrison Co., Jackson Co., Knox Co., Lake Co., Marion Co., Marshall Co., Posey Co., Putnam Co., Switzerland Co., Vigo Co., Warren Co.). Iowa (Ames, Hedrick, Iowa City, Jefferson, Ledges State Park, Mount Pleasant, Sac City, Shenandoah, Sioux City, Storm Lake, Unionville, Winterset, Adair Co., Carroll Co., Cass Co., Keokuk Co., Monona Co., Marshall Co., Wapello Co.). Kansas (Alta Vista, Argentine, Benedict, Lawrence, Manhattan, Onaga, Topeka, Doniphan Co., Neosho Co.). Kentucky (Sanborn). Louisiana (Alexandria, Chastine, New Orleans, Ponchatoula, Tallulah, Winnfield). Maryland (Baltimore, Hyattsville, Plummers Island, Plum Point, Riverdale, Seat Pleasant, Sparrows Point, Takoma Park). Massachusetts (Medford, Williamstown). Michigan (Ann Arbor, Detroit, East Lansing, Galesburg, Lizzie, Owosso, Gratiot Co., Washtenaw Co.). Minnesota (Mississippi Bluff, Houston Co.). Mississippi (Bruce, Charleston, Leakesville, Lucedale, Lumberton, Natchez, New Augusta, State College). Missouri (Brunswick, Columbia, Helena, Kansas City, Keytesville, Maitland, Maryville, Metz, New Hartford, Palmyra, Rutledge, Saint Louis, Santa Fe, Warsaw). Nebraska (Hastings, Lincoln, Omaha, Platte, Plattsmouth). New Jersey (Boonton, Clementon, Englewood, Lakewood, Manumuskin, Mauricetown, Phillipsburg, Pine Barrens, Rahway, Vineland). New York (Buffalo, Clermont, Danby, Delmar, East Aurora, Elbridge, Flatbush, Flushing, Georgetown, Ithaca, Lancaster, Lockport, Orient, Pike, West Point, Greene Co.). North Carolina (Alexander, Asheville, Black Mountain, Cape Hatteras, Chapel Hill, Edenton, Elizabeth City, Murphy, Raleigh, Southern Pines). Ohio (Athens, Aurora, Bluffton, Columbus, Durbin, Georgesville, Hamilton, Lagrange, Marietta, Millport, North Olmsted, Urbana, Wooster, Ashtabula Co., Delaware Co., Fairfield Co., Greene Co., Hancock Co., Highland Co., Hocking Co., Licking Co., Meigs Co., Monroe Co. Morrow Co., Perry Co., Putnam Co., Scioto Co.). Oklahoma (Locust Grove, Okemah, Stillwater, McCurtain Co., Osage Co., Payne Co.). Pennsylvania (Bethlehem, Darby, Easton, Essington, Harrisburg, Jeannette, Lime Rock, Olney, Overbrook, Patton, Philadelphia, Pittsburgh, Scranton, Tinicum, Wyoming, Allegheny Co., Delaware Co., York Co.). South Carolina (Clemson, Columbia, Savannah River Plant). Tennessee (Deer Lodge, Elmwood, Madison, Memphis, Nashville). Texas

(Brownsville, College Station, Columbus, Cypress Mill, Dallas, Fedor, Gall, Harrisburg, Houston, Jacksonville, Kerrville, Liberty, Mexia, New Braunfels, Palestine, San Felipe, Seabrook, Seguin, Texarkana, Uvalde, Victoria, White Rock Lake, Burnet Co., Colorado Co., Eastland Co., Hays Co.). Virginia (Belle Haven, Cherrydale, Falls Church, Fort Monroe, Great Falls, Mount Vernon, Suffolk, Nelson Co.), West Virginia (Cave Mountain).

Canada: Ontario (Almonte, Grand Bend, Grimsby, Ottawa, Picton, Point Pelee, Tillsonburg, Toronto, Turkey Point, Hastings Co.). Quebec (Coteau Junction, Montreal).

Platydema ruficolle Laporte and Brullé

PLATE 5 (FIGS. 47, 48)

Platydema ruficollis Laporte and Brullé, 1831, p. 375.—Haldeman, 1848, p. 102.

Neomida sanguinicollis Melsheimer, 1846, p. 61.

Platydema ruficolle Laporte and Brullé.—Horn, 1870, p. 382.—Blatchley, 1910, p. 1263.

DESCRIPTION.—Small, short, broadly oval, strongly convex; head, pronotum, scutellum, and margins of elytra reddish, elytra black, feebly shining. Head broadly arcuate in front, epistomal margin almost truncate, epistomal suture usually well defined; surface uniformly coarsely and densely punctured; eyes small, widely separated both above and below, convex, deeply and broadly emarginate anteriorly, anterior dorsal margin deeply set in head, posterior margin sharply elevated, separated ventrally by a distance equal to from 2 to 3 times the longer axis of one eye; mouthparts light reddish brown, terminal segment of maxillary palpus broadly triangular; antennae uniformly reddish brown from base to apex. Pronotum 2.2 to 2.4 times as broad as long, strongly narrowed from base to apex, sides strongly arcuate, margined only by a very fine reflected bead; basal angles rectangular, apical angles narrowly rounded; disc finely and sparsely punctured, more coarsely so laterally. Elytra convex, sides strongly rounded, narrowly margined with distinct bead; striae moderately impressed, especially laterally and apically, coarsely punctured; scutellar striae absent; intervals distinctly convex, very minutely but moderately densely punctulate. Prosternal process horizontal, its apex broadly triangular and prominent, margined between coxae. Ventral surface of pronotum concave, smooth, very thin on lateral margins; entire ventral surface reddish brown, legs usually lighter. Metasternum and basal four abdominal sternites with widely spaced, abnormally larger punctures, apical two abdominal sternites finely and rather sparsely punctulate, fourth sternite conspicuously impressed laterally. Male aedeagus with basal sclerite comparatively longer than apical sclerite, no constriction between

them (pl. 5, figs. 47, 48). Measurements: length 3.3–4.4 mm.; width 2.0–2.5 mm.

Remarks.—The fairly consistant coloration of this species combined with the glossy lustre of the entire dorsum, the very large, well-separated punctures of the metasternum and first four abdominal sternites and the absence of scutellar striae are sufficient to distinguish this species from any other North American member of the genus.

Because of its glossy lustre, it bears a superficial resemblance to *P. micans,* from which it may be separated by the normally placed outermost elytral striae, the minutely and indistinctly punctured elytral intervals, and the much finer and sparser punctures of the head.

Despite the difference in dorsal surface lustre, its nearest sympatric relative appears to be *P. ruficorne,* as indicated by the male genitalia. Otherwise, the two are quite similar in overall appearance.

Even in the small series available for study, there is a rather wide range of color variation, and since this character is given considerable taxonomic weight, it seems in order to describe it in greater detail. The above description of reddish head, pronotum, scutellum, and elytral margins applies to the majority of specimens, however, the specimens at hand range from one which is almost completely black to several which are almost uniformly reddish brown. In all of them, the previously mentioned parts are invariably lighter than the disc of the elytra. Several specimens were examined in which the black of the elytra extended well onto the pronotum, obliterating the red except at the margins and apex, the scutellum remaining red as usual. At the other extreme were three specimens in which the elytral base was as red as the scutellum and a narrow band of the same color extended a slight distance down the elytral suture. It is quite probable that specimens will be encountered which exhibit even greater deviation from the normal coloration, in which case there are several other equally useful characters which will adequately distinguish this species from its congeners.

Types.—*Platydema ruficollis* Laporte and Brullé: not seen; type locality, "Philadelphie." *Neomida sanguinicollis* Melsheimer: represented in Melsheimer collection (MCZ) by one specimen without data or accession number; type locality, Pennsylvania. A very typical specimen of *P. ruficolle.*

Specimens examined.—From the following localities, 29:

United States: Arkansas (Bentonville, Hope). Florida (Pensacola). Georgia (Dunwoody). Illinois. Indiana (Lake Co., Posey Co., Putnam Co.). Iowa (Burlington). Mississippi (Lucedale, Ocean Springs). New Jersey (Lakehurst). Oklahoma (Ardmore). South Carolina (Florence). Texas (College Station, Dallas, 10 miles east of Shelbyville). Virginia (Cape Henry, Fredericksburg).

***Platydema ellipticum* (Fabricius)**

Plate 5 (Fig. 37)

Tenebrio ellipticus Fabricius, 1798, p. 49.
Mycetophagus ellipticus Fabricius, 1801, p. 566.
Platydema elliptica (Fabricius).—Laporte and Brullé, 1831, p. 380.—Candèze, 1861, p. 46 (larva).
Platydema ellipticum (Fabricius).—Horn, 1870, p. 383.—Blatchley, 1910, p. 1263. Weiss, 1919, p. 276 [biology].

Description.—Elongate elliptical, moderately convex, dark brown to black, with irregular reddish spot on each elytron, dull in lustre. Head coarsely and densely punctured, epistomal suture clearly outlined; eyes moderately large, broadly and deeply emarginate anteriorly; mouthparts and antennae dark brown to black, terminal segment of maxillary palpus robust, elongate oval, obliquely truncate apically. Pronotum almost twice as broad as long, sides evenly arcuate and rather strongly convergent from base to apex, apex feebly emarginate, base slightly bisinuate, both basal and apical angles sharply rectangular, lateral margins scarcely expanded, bead very fine, surface coarsely and densely punctured, especially laterally. Elytra with sides nearly parallel, narrowly margined, bead fine and strongly reflected, striae slightly or not at all impressed, finely and distantly punctured, intervals subconvex to flat, minutely and sparsely punctulate, surface black with a prominent, irregularly margined red spot extending obliquely from humeral region of each elytron toward suture, sometimes actually attaining it. Ventral surface of pronotum coarsely and densely punctured, forming longitudinal ridges; prosternal process horizontal, its apex prominent and acute posteriorly; entire ventral surface dark brown or black, shining, coarsely and densely punctured, punctures smaller and more widely separated on apical two abdominal sternites. Male aedeagus with basal sclerite robust and subequal in length to apical sclerite, which is parallel sided and acutely pointed apically (pl. 5, fig. 37). Measurements: length 4.4–7.7 mm.; width 2.3–3.8 mm.

Remarks.—This species is unique among the North American components of the genus *Platydema* in having the distinct, constant color pattern described above. From Central Mexico, south through most of South America, a number of very similar species enter the fauna. These consist of moderate to rather large forms, dull black dorsally, attractively patterned with spots and bands in various combinations and arrangements of this same reddish color noted in *P. ellipticum*. A number of these have been studied and on the basis

of limited series it appears that these patterns are quite constant and afford excellent diagnostic characters.

Most nearly approximating *P. ellipticum* are *P. högei* Champion, from Mexico, and *P. affine* Laporte and Brullé, from Brazil, Argentina, and Uruguay. Both of these have two transverse bands of red on each elytron; in the latter species, the posterior band encompasses the entire apex of each elytron while in *P. högei*, the extreme apex is black. Two other species with obviously close affinities include *P. diophthalmum* Laporte and Brullé, from most of Central America and Cuba, and *P. bimaculatum* Champion, from Central America, both of which have a single, rounded red spot on each elytron; in the former species the spots are located near the base of each elytron, in the latter, they are found near the middle.

Weiss (1919) reports that *P. ellipticum* is commonly associated with the shelf fungus, *Polyporus gilvus*, in New Jersey. Both larvae and adults were found in this fungus in mid-September.

TYPE.—Not seen; type locality, "Carolina."

SPECIMENS EXAMINED.—From the following localities, 1015:

United States: Alabama (Cheaha State Park, Mobile, Monroeville, Oxford). Arkansas (Fayetteville, Hope, Washington Co.). Colorado (Denver). Connecticut. Delaware (Bombay Hook, Glasgow, Newark). District of Columbia. Florida (Biscayne Bay, Brooksville, Cresent City, Dunedin, Enterprise, Gainesville, Kissimmee, Lakeland, Miami, Palatka, Pine, Punta Gorda, Sanford, Tildenville, Winter Park, Citrus Co., Duval Co.). Georgia (Athens, Boston, Cornelia, Dunwoody, Hartwell, Milledgeville, Savannah, Thomasville, Tifton). Illinois (Centralia, Fort Sheridan, Galesburg). Indiana (Hovey Lake, La Porte, Terre Haute, Crawford Co., Jennings Co., Knox Co., Lagrange Co., Marion Co., Posey Co., Vigo Co.). Iowa (Ames, Clermont, Fort Madison). Kansas (Argentine, Lawrence, Lone Star Lake, Manhattan, Onaga, Topeka). Kentucky (Louisville). Louisiana (Baton Rouge, Bayou Sara, Greenwell Springs, Negreet, New Orleans, Opelousas, Ponchatoula). Maryland (Edgewood, University Park). Mississippi (Leaf, Lucedale, New Augusta, State Line, Jackson Co.). Missouri (Columbia, Corondelet, Kansas City, Rosati, Saint Charles, Saint Louis, Valley Park). New Jersey (Anglesea, Blackwood, Englewood, Merchantville, Rahway, Riverton, Springfield, Vineland). New York (Bergen Beach, Flushing, Jamaica, Molliswood, New York City, Queens, Rosedale, Staten Island). North Carolina (Southern Pines, Tryon). Ohio (Athens, Canaan, Cincinnati, Columbus, Holmesville, Allen Co., Delaware Co., Fayette Co., Greene Co., Hocking Co., Perry Co., Vinton Co.). Oklahoma (Osage, Stillwater). Pennsylvania (Angora, Castle Rock, Essington, Fern Rock, Germantown, Glenolden, Harrisburg, Jeannette, Linglestown, Overbrook, Pittsburgh, Uniontown, Unionville, Wilmerding, Wyoming, Allegheny Co.). South Carolina (Camden, Greenville, Jackson, Sassafrass Mt.). Tennessee (Madison, Memphis). Texas (Bay City, Columbia, Dallas, Harrisburg, Houston, Lake Charlotte, New Braunfels, Paris, Rock Island, Victoria, Cherokee Co., Colorado Co.). Utah. Virgina (Cobham, Falls Church, Lake Drummond, Vienna, Fluvanna Co., Nelson Co.).

Platydema flavipes (Fabricius)

Plate 5 (Figs. 45, 46)

Mycetophagus flavipes Fabricius, 1801, p. 567.

Platydema flavipes (Fabricius).—Laporte and Brullé, 1831, p. 388.—Horn, 1870, p. 382.—Blatchley, 1910, p. 1263.

Platydema basalis Haldeman, 1848, p. 101.

Description.—Elongate oval, subdepressed, black, dull in lustre. Head uniformly arcuate in front, slightly reddish along margin, convex between eyes, epistomal suture poorly defined; surface coarsely, densely, almost confluently, punctured; eyes moderately strongly convex, feebly emarginate anteriorly, separated ventrally by a distance subequal to twice the longer axis of one eye; mouthparts light reddish brown, terminal segment of maxillary palpus short, broadly triangular; basal 3 or 4 antennal segments light reddish brown, the remaining segments dark brown to black. Pronotum twice as broad as long, sides evenly and strongly arcuate, finely margined, basal angles rectangular, apical angles narrowly rounded and moderately prominent; surface finely, shallowly but rather densely, punctured on disc, punctures abruptly larger and more deeply impressed laterally. Elytra with sides nearly parallel, striae distinctly impressed, very coarsely and deeply punctured, intervals strongly convex, minutely and sparsely punctulate, punctures discernable only at high magnification. Prosternal process convex between coxae, its apex acute and secondarily slightly reflected. Ventral surface of prothorax usually thickened and convex; entire ventral surface reddish, coarsely and densely punctured except two apical abdominal sternites, which are finely and sparsely punctate. Male genitalia short, relatively small, constricted between basal sclerite and lateral lobes (pl. 5, figs. 45, 46). Measurements: length 3.6–5.4 mm.; width 1.7–2.6 mm.

Remarks.—The pale basal segments of the antennae immediately distinguish this from any other nearctic species of *Platydema*. It differs from its nearest relative, *P. nigratum* (Motschoulsky), in its smaller average size, the uniformly dark antennal club, the much coarser overall punctation and in other more subtle characters. The male genitalia (pl. 5, figs. 45, 46) are quite distinctive.

Types.—*Mycetophagus flavipes* Fabricius: not seen; presumably lost; type locality, "Carolina." *Platydema basalis* Haldeman: MCZ 8370. The specimen bearing this type label is hereby designated a lectotype. It is one of six Haldeman specimens incorporated into the LeConte collection under the name *P. flavipes*, and is the only one labelled *P. basalis*, presumably by Haldeman himself. It bears an orange "So. St." label and no specific locality is given in the original description other than that it "inhabits from New York to

Georgia." It is a very typical specimen of *P. flavipes*, and this is a clear case of absolute synonymy.

Specimens examined.—From the following localities, 548:

United States: Alabama (Auburn, Cheaha State Park, Marion, Mobile, Selma, Tuscaloosa). Arkansas (Hope). Delaware (Fenwick Island). District of Columbia. Florida (Archer, Avalon, Belleair, Biscayne Bay, Brooksville, Capron, Coconut Grove, Dunedin, Edgewater, Elfers, Enterprise, Fruitland Park, Gainesville, Haulover, Highlands Hammock State Park, Homestead, Kissimmee River, La Belle, Lake City, Lake Worth, Miami, Monticello, Naples, Ocala, Odessa, Orange Park, Ormond Beach, Palatka, Paradise Key, Pine, Punta Gorda, Royal Palm State Park, Saint Augustine, Sand Point, Sanford, Sarasota, Tampa, Winter Park, Dade Co., Duval Co., Citrus Co., Highlands Co., Levy Co., Marion Co., Pinellas Co., Polk Co., Putnam Co.). Georgia (Adairsville, Albany, Athens, Atlanta, Baconton, Billys Island, Brunswick, Buckhead, Camilla, Cartersville, Clarkesville, Clyo, Dunwoody, Milledgeville, Ochlochnee, Saint Simons Island, Savannah, Stone Mountain, Swainsboro, Thomasville, Thomson, Thunderbolt, Tybee Island, Warrenton). Indiana (Clark Co., Posey Co.). Kansas (Riley Co.). Kentucky. Louisiana (New Orleans, Ponchatoula, Winnfield). Maryland. Massachusetts (Brookline, Cambridge, Hopkinton, Lowell, Milton, Springfield, Wilbraham). Mississippi (Avera, Leaf, Leakesville, Lucedale, New Augusta). New Hampshire (Durham). New Jersey (Jamesburg, Lakehurst, Lakewood, Riverton, Vineland). New York (Flushing, Ithaca, New York City, Orient, Pinelawn, Riverhead, Yaphank). North Carolina (Asheville, Boardman, Chapel Hill, Saluda, Southern Pines, Tryon). North Dakota (Beach). Ohio (Athens). Pennsylvania (Jeannette, Pittsburgh). South Carolina (Charleston, Clemson College, Greenwood, Jackson). Tennessee (Deer Lodge, Elmwood). Texas (Anahuac, College Station, Columbus, Dallas, Deweyville, Flatonia, Gail, Handley, Karnack, San Felipe, Victoria, Waco). Virginia (Cape Charles, Charlottesville, Falls Church, Fort Monroe, Newport News, Norfolk, Sherrydale).

Platydema nigratum (Motschoulsky)

Plate 5 (Figs. 38, 39)

Platydema janus Horn, 1870, p. 382 (not Fabricius, 1801, p. 566) [misidentification].
Neomida nigrata Motschoulsky, 1873, p. 478.
Platydema pernigrum Casey, 1884, p. 49.—Horn, 1885, pp. 111, 113.
Platydema subquadratum (Motschoulsky).—Champion, 1886, p. 188; 1893, p. 538.—Blaisdell, 1923, p. 277 [misidentification].

Description.—Subquadrate to elongate oval, feebly convex, dark brown to black, dull in lustre. Head evenly arcuate in front, anterior margin reddish, flattened or feebly convex between eyes, epistomal suture well defined; surface finely and very densely, almost confluently, punctured; eyes large, convex, feebly emarginate anteriorly, separated ventrally by a distance subequal to about 1.7 times the longer axis of one eye; mouthparts light reddish brown, terminal segment of maxillary palpus elongate triangular; basal four and apical segment of antennae light reddish brown, segments 5–10 dark brown to black. Pronotum twice as broad as long, sides strongly converging

from base to apex, feebly arcuate to almost straight, finely margined, basal angles rectangular, apical angles broadly rounded, surface uniformly finely, shallowly, and densely punctured. Elytra with sides nearly parallel to feebly arcuate, striae feebly impressed, finely and shallowly punctured; intervals flat to subconvex, minutely, rather sparsely, but usually distinctly, punctulate, even at low magnifications. Prosternal process variable, never extremely convex between coxae and not horizontal but tending toward the two extremes even among individuals from the same population. Ventral surface of pronotum concave, not thickened, finely and sparsely punctate to smooth; metasternum finely and densely punctate medially, smooth or with a few scattered coarse punctures caudo-laterally; metepisternum with a few scattered coarse punctures; abdominal sternites all finely and densely punctured, punctures becoming coarser on lateral portions of each segment. Male aedeagus with basal sclerite unusually large, about 1.7 times the length of the parallel-sided apical sclerite which has the apex acutely pointed, base truncate (pl. 5, figs. 38, 39). Measurements: length 4.6–7.8 mm.; width 2.6–4.1 mm.

REMARKS.—This species may be separated from all other members of the genus *Platydema* known to occur north of the Rio Grande by the antennal coloration described above. South of this boundary, positive identification is made troublesome by the addition of at least two other quite distinct and obviously closely related forms. The situation is further complicated by the existence in the literature of a number of names which cannot with any certainty be associated with any of these species, without consulting the types.

One of these occurs at least as far north as Tamazunchale in San Luis Potosi, Mexico, where on at least two separate occasions it has been collected in company with *P. nigratum*. These two species occupy the same range southward at least to Panama. Champion (1886) has referred to this second species as *P. sobrinum* Chevrolat, but specimens submitted to M. Villiers did not compare at all with the type in the Paris Museum. For the purposes of the present study it will remain nameless.

P. nigratum may be known from this second species by its more parallel form, its more coarsely and densely punctured head, and its much less convex pronotum, which is always distinctly and frequently coarsely and densely punctured, and the finely but almost always distinctly punctured elytral intervals. Each is clearly recognizable and no intergradation of diagnostic characters has been observed in the material at hand.

A third species, closely resembling the two described above, possibly represents a distinct species apparently undescribed. It most

closely approximates *P. nigratum*, with which it shares the characters of the conspicuously punctured pronotum and elytral intervals. The essential difference between the two lies in the distance separating the eyes, which seems constant in the two forms. In *P. nigratum*, this distance is always subequal to 1.7 times the longer axis of one eye, while in the other form, it is at least 3 times the eye length. The lateral punctures of the basal three abdominal sternites are extremely coarse and widely separated in the new form. I have seen only three specimens, all from Mexico.

All of the above three taxa look very much alike superficially, especially since they all have the identical system of antennal coloration. In addition, they are inseparable on the basis of the male genitalia. It is possible that they are all variations of the same species, but since they are readily distinguishable, they may be regarded as distinct until additional contrary information is available.

The system of antennal coloration mentioned above is by no means restricted to members of this *P. nigratum* complex. It has been a source of confusion which persists even into the present paper. There are a number of South and Central American forms which also exhibit the character, but all of these studied to date were found to be distinguished from one another, or at least broken down into workable units, by the structure of the male genitalia.

The principle variations exhibited by *P. nigratum* are the relative convexity of the prosternum, which is subject to a rather wide degree of variation and should not be relied upon as a taxonomically useful character, and the relative degree of punctation of the elytral intervals. Many specimens appear to be covered by a fine velvety pile, rendering it difficult or impossible to distinguish punctures; there is also a decided tendency for grease to clog the punctures, with the same effect. In instances of doubt, it is best to clean specimens thoroughly with ether and a small brush.

Types.—*Platydema janus* Horn (not Fabricius, 1801). This name is included in the synonymy since it is the first reference in the literature to the present species. Horn (1870) referred specimens of this species to *P. janus* (Fabricius), described from Peru. Since no specimens of *P. nigratum* have been seen south of Nicaragua, it seems best to assume, as suggested by Champion (1886), that *P. janus* represents another species. The Fabrician types were not seen, but the material upon which Horn's revision is based (ANSP) is typical of *P. nigratum* as defined above. *Neomida nigrata* Motschoulsky. Type in UMMZ. Two Texas specimens sent for comparison corresponded fully regarding all characters (Kelejnikova, in litt.). In addition, she pointed out that Motschoulsky failed to indicate that

the last antennal segment is lighter than the preceding ones. Type locality, "Californie." *Neomida subquadrata* Motschoulsky (auctor). According to Kelejnikova (in litt.), the type (UMMZ) is in very poor condition but quite distinct from specimens of any species submitted for comparison. An outline sketch of the type, kindly sent by S. Kelejnikova, indicates a very robust species. Undoubtedly the remarks concerning *P. janus* (Fabricius) would apply equally well here, this name referring to one of the host of Central and South American species, all having a frustratingly similar external appearance. Type locality, "Amerique Centrale." *Platydema pernigrum* Casey. Holotype USNM 46814 and paratype USNM 48814. These specimens fall well within the range of normal variation encountered in this species. The following notes were made with the types plus Casey's specimens of what he considered to be typical "*janus*" (=*nigratum*) before me: "The holotype and paratype are larger than any of Casey's specimens of *P. nigratum.* True, they are blacker than the latter specimens, but the differences in head sculpture to which he alludes seems quite nebulous to me. The paratype is the cleaner of the two and for this reason its interstrial areas appear slightly more convex. Also, in the paratype, these areas are quite evidently punctured; not so on the holotype. Casey's eye length character escapes me completely and all diagnostic characters which he mentions are well within the range of normal variation which I have observed for this species."

The Casey collection contains seven Texas specimens of *P. nigratum* placed under the name "*janus*" and one British Honduras and two Arizona specimens placed under "*subquadratum.*" With such short series available to him, it is understandable why he chose to regard them as distinct. Where he had little more than a dozen specimens on which to base his conclusions, I have examined almost 300 specimens from scattered localities throughout the range of the species. Type locality, Arizona (Morrison).

Platydema ventrale Chevrolat, described from Mexico, was listed as a synonym of the present species by Champion (1886) who states that he "examined a typical example of *P. ventrale* and see no reason for separating it from" the present species. This synonymy was followed in later checklists (Leng, 1920; Gebien, 1911; Blackwelder, 1945). Specimens of *P. nigratum* from Mt. Colima, Mexico, were compared with the Chevrolat type by A. Villiers who states (in litt.) that they do not correspond. According to Villiers, *P. ventrale* is broader, more convex, and less parallel than the specimens submitted. Chevrolat's species must therefore be considered valid until a more comprehensive study of the Central American species of *Platydema* can be undertaken.

Specimens examined.—From the following localities, 297: United States: Alabama (Auburn, Mobile). Arizona (Arivaca, Catalina Springs, Cibola, Fort Yuma, Galiuro Mts., Globe, Huachuca Mts., Nogales, Phoenix, Sabino Canyon, Santa Catalina Mts., Superstition Mts., Tucson, Willcox). California (Needles, San Diego, San Jose Island, Yuma). Florida (Capron, Bartow, Brooksville, Dunedin, Enterprise, Gainesville, Highlands Hammock State Park, Homestead, Key Largo, Key West, Lake Harney, Lake Worth, Naples, Punta Gorda, Royal Palm Park, Saint Lucie, Sanford, Sarasota). Georgia (Brunswick). Indiana (Marion Co.). Kansas (Benedict). Louisiana. Mississippi (Lucedale). New Mexico (Albuquerque). North Carolina. South Carolina. Texas (Brownsville, Devils River, Montell, New Braunfels, San Diego, Victoria, Hidalgo Co.).

Cuba: Cienfuegos, Baraguá.

Lower California: Cape San Lucas, Comondu, El Triunfo, Las Animas Sierra Laguna, San Bartolo.

Mexico: Acahuizlotla, Acaponeta, Agua Marina near Alamos, Ciudad del Maíz, Ciudad Obregon, Cuernavaca, Eldorado, Jicaltepec, Minatitlán, Mount Colima, Santa Rosa, Tamazunchale, Tampico, Tepic.

British Honduras: Manatee District, Rio Hondo.

Honduras: Roatán Island.

Nicaragua.

Costa Rica: La Caja near San José.

Platydema erythrocerum Laporte and Brullé

Plate 5 (Figs. 43, 44)

Platydema erythrocera Laporte and Brullé, 1831, p. 355.
Platydema erythrocerum Laporte and Brullé.—Horn, 1870, p. 382.
Neomida flavicornis Motschoulsky, 1873, p. 479 [new synonymy].

Description.—Elongate oval, rather strongly convex, light reddish brown to almost black, sometimes with purplish caste. Head narrowly rounded in front, epistomal suture well defined, clypeus convex and distinct; surface minutely and obscurely punctulate; males with two thick, very blunt, parallel, forward projecting horns on frons immediately between eyes, a deep abruptly defined impression between them; females with short, very blunt tubercles on frons, a shallow impression between them; eyes large, convex, separated ventrally by a distance subequal to the longer axis of one eye; mouthparts pale yellowish or reddish, terminal segment of maxillary palpus moderately short, rather narrowly triangular; basal four or five antennal segments pale yellowish, the remaining segments dark brown except apical one which is frequently all or in part paler in color. Pronotum slightly more than twice as broad as long, sides feebly and evenly arcuate from base to apex, marginal bead very fine, feebly reflected, basal angles obtusely rounded, apical angles broadly rounded; surface indistinctly punctate, punctures minute and widely spaced. Elytra with sides nearly parallel to feebly arcuate, striae shallowly or not at all impressed, punctures deep, moderately coarse

and usually rather widely spaced; intervals flat to subconvex, impunctate. Prosternal process extremely narrow, horizontal, its apex greatly prolonged behind and acutely pointed. Ventral suface of prothorax smooth and polished, impunctate; sterna and pleura of meso- and metathorax practically smooth, with only a few minute, widely scattered punctures; abdominal sternites finely, sparsely, and rather uniformly punctured, usually with faint longitudinal wrinkles, fourth sternite with prominent lateral impressions. Male genitalia (pl. 5, figs. 43, 44) with apical sclerite drastically reduced, only one-fifth as long as basal sclerite, entire aedeagus tapering gradually to the acute apex. Measurements: length 3.2–4.4 mm.; width 1.7–2.6 mm.

Remarks.—This is one of the most easily characterized members of the genus *Platydema* in the Nearctic region. The only other species possessing frontal horns are *P. excavatum*, *P. cyanescens*, and *P. teleops*, and all these are quite shiny in lustre with their horns thin and sharply pointed. The presence or absence of these horns cannot be considered reliable in establishing relationships within this genus. A comparison of the male genitalia of *P. erythrocerum* and the three other horned species indicates that they stand rather far apart phylogentically.

The affinities of this species clearly lie with the tropical *P. undatum* Chevrolat, which occurs at least as far north as Jalapa, Veracruz, Mexico, and extends southward well into Brazil (Santarém). The male genitalia illustrate a close relationship, but in *P. undatum*, the horns of the male are reduced to small tubercles as in the female of *P. erythrocerum* and the females lack even the tubercles. Both species are dull in lustre and have the same antennal coloration. Whereas *P. erythrocerum* is unicolorous, *P. undatum* is attractively marked with variable bands of orange outlined in dark brown on a yellow ground color. Two other species, *P. rodriguezi* Champion and *P. hondurense* Champion, according to their descriptions, should also prove to be members of this species group.

Type.—Not seen. The description is quite adequate to establish the identity of this species. According to Laporte and Brullé (1831), "Cet insecte habite L'Amérique méridionale." This I have interpreted to mean southern North America and not South America. The type of *Neomida flavicornis* (UMMZ) corresponds to specimens from Mississippi sent for comparison (Kelejnikova, in litt.). The description is very adequate for its determination. Type locality, "Nouvelle-Orléans et à Mobile."

Specimens examined.—From the following localities, 179:

United States: Alabama (Auburn, Peterman, Tuscaloosa). Arkansas. Delaware (Newark). District of Columbia. Florida (Bartow, Brooksville, Capron, Dunedin, Enterprise, Gainesville, Haulover, Highlands Hammock State Park,

Oneco, Orlando, Ormond, Paradise Key, Punta Gorda, Royal Palm Park, Sarasota, Tampa, Highlands Co., Leon Co., Levy Co., Marion Co.). Georgia (Atlanta, Barnesville, Dallas, Dunwoody, Thomasville, Tifton, Clarke Co.). Illinois (Olive Branch). Indiana (Terre Haute, Posey Co., Putnam Co., Vigo Co., Warren Co.). Kansas. Kentucky (Taylor Co.). Louisiana (Baton Rouge, Harahan, Logansport, New Orleans, Tallulah). Maryland (Hyattsville). Mississippi (Lucedale, Lula, Natchez, New Augusta, State College, State Line). Missouri (Kansas City). New York. North Carolina (Chimney Rock). Ohio (Tuppers Plains, Athens Co., Fairfield Co.). Oklahoma (Pearson, Tulsa). South Carolina (Swansea). Tennessee (Nashville). Texas (Dallas, Harrisburg, Houston, Jacksonville, Liberty, Longview). Virginia (Mount Vernon, Suffolk, Nelson Co.). West Virginia (Weston).

Platydema wandae, new species

PLATE 5 (FIG. 32)

DESCRIPTION.—Large, broadly oval, moderately convex, dark brown to black, dull in lustre. Head evenly arcuate in front, anterior margin reddish, flattened between eyes, epistomal suture well defined; surface very finely and densely punctulate; eyes large, convex, deeply emarginate anteriorly, entirely flush with head surface medially, separated ventrally by a distance of 1.2–1.5 times the longer axis of one eye; mouthparts, antennae, legs, and entire ventral surface, including epipleura, reddish brown; terminal segment of maxillary palpus short, narrowly triangular. Pronotum slightly more than twice as broad as long, strongly narrowed from base to apex, sides uniformly arcuate, scarcely margined, bead extremely fine and reflected, basal angles rectangular, apical angles obtuse and narrowly rounded; surface uniformly minutely and sparsely, usually indistinctly, punctulate. Elytra evenly convex, sides broadly rounded, narrowly margined, bead fine and strongly reflected; striae feebly or not at all impressed, very finely punctured; intervals feebly convex to flat, minutely but densely punctulate. Ventral surface of pronotum concave, practically smooth; prosternal process broad and flat between coxae, horizontal, its apex prominent; metasternum and all pleural sclerites smooth with minute, widely spaced punctures; abdominal sternites finely and sparsely punctured, especially laterally, each with at least a faint lateral depression, particularly pronounced on fourth sternite. Male aedeagus (pl. 5, fig. 32) lightly scelerotized, apical sclerite acutely pointed, continuous at base with basal sclerite, penis struts indistinct. Measurements: length: 5.1–7.8 mm.; width 3.2–4.9 mm. (holotype 6.5 mm., 4.2 mm.).

REMARKS.—This is the largest species of *Platydema* to be found north of the Rio Grande. Of the North American forms, it resembles *Platydema ruficorne* (Sturm) most closely, but, in addition to its larger size, there are other noteworthy differences between the

two as follows: the pronotum in *P. wandae* is always indistinctly punctulate due to a velvety pile which usually covers the entire dorsum (even when this pile is removed, the punctures are seen to be quite small and inconspicuous); the ventral punctures are relatively much finer and more sparse than in *ruficorne*; in cases of doubt, the male genitalia have proved to be sufficiently diagnostic. According to all available records, there is no overlap between the ranges of the two species. Within its range, *P. wandae* is most likely to be confused with *P. nigratum* (Motschoulsky), which is more elongate in form and has the basal three or four and the apical antennal segments paler than the remaining segments. Here, too, the genitalia have proved to be the most reliable character to utilize in cases of doubt.

In Central and South America there is a bewildering array of species which may, at best, be characterized as large, rotund and velvety-black. To further complicate the situation, there is an equally bewildering list of names, most of which were proposed by Chevrolat, and none of which are detailed enough to enable one to associate names with insects. Champion (1886) utilized with reservations a number of these Chevrolat names but obviously was not at all certain that he was applying them correctly. He was able to examine specimens of *P. rotundatum* Chevrolat, named by Chevrolat himself, and apparently had a clear concept of at least that species. Three of Champion's specimens of *P. rotundatum* have been studied critically and were found to be quite distinct from, although evidently quite closely related to *P. wandae.*

It is regrettable that yet another name must be added to the already unwieldy list of those species of *Platydema* belonging to this complex. Repeated attempts to associate the present species with any of the available names were unsuccessful. Until further Central American material is accumulated, the Chevrolat types are examined, and the validity of his names is determined, any conclusions would be highly inferential and speculative.

J. N. Knull (1960, in litt.) reports that the adults of this species are nocturnal. He observed them in numbers on shelf fungi which grew from bases of oak stumps and dead trees, 3 miles west of Portal, Arizona, in the Chiricahua Mountains. Professor Knull was able to obtain the large portion of the type series mentioned below by placing fungi at the bases of dead trees and periodically collecting the beetles from beneath them. He also states that they are attracted to light.

I take great pleasure in naming this interesting beetle in honor of my wife, Wanda Elaine Triplehorn.

Types.—Holotype male, USNM 66050: Nogales, Ariz., Aug. 28, 1906, F. W. Nunenmacher. Paratypes: 5, same data (CAS); 1, same data (Minn); 2 same data (KSU); 6, Nogales, Ariz., Sept. 25, 1906, F. W. Nunenmacher (CAS); 1, Nogales, Ariz., Aug. 24, 1906, F. W. Nunenmacher (CAS); 1, Nogales, Ariz., Aug. 12, 1906, F. W. Nunenmacher (CAS); 2, same data (USNM); 3, Patagonia, Ariz., June 6, 1936, M. Cazier (CSS); 41, Baboquivari Mts., Ariz., F. H. Snow (UKan); 5, same data (CAT); 2, same data (MCZ, H. C. Fall collection); 1, Chiricahua Mts., Ariz., July 22, 1953, DJ and JNK (OSU); 116, Chiricahua Mts., Ariz. July 9, 16, 23, 30, Aug. 7, 15, 1959, DJ and JNK (OSU, CAT, BMNH, UMMZ). Also examined: 1 specimen, Albuquerque, N. Mex. Aug. 1919, Long (CAS).

Platydema inquilinum Linell

Plate 5 (Figs. 35, 36)

Platydema inquilnum Linell, 1899, p. 183.

Description.—Elongate elliptical, moderately convex, dark reddish brown, feebly shining. Head with clypeus very large, trapezoidal, posterior angles but narrowly separated from eyes, epistomal margin truncate; eyes coarsely faceted, broadly but shallowly emarginate anteriorly, slightly convex dorsally, sunken below surface of head medially, separated ventrally by about 1.5 (1.3–1.6) times the longer axis of one eye; antennane, mouthparts, and legs concolorous with dorsal surface; antennae short, not extending posteriorly beyond pronotal base, terminal segment sometimes slightly lighter than those preceding; terminal segment of maxillary palpus narrowly oval, attenuate apically, obliquely truncate at tip; mentum conspicuously bearded with coarse hairs, especially in males; entire head surface finely and densely punctate. Pronotum transverse, about twice as broad as long, sides feebly arcuate, rather strongly convergent from base to apex, margins finely beaded, not at all expanded; apex truncate, base broadly bisinuate; apical angles obtuse and narrowly rounded, basal angles abruptly acute, slightly overlapping humeral angles of elytra; entire surface finely and densely punctured. Elytra with lateral margins evenly arcuate, bead fine and slightly reflected; striae scarcely impressed, finely punctured; intervals flat on disc, rather strongly convex laterally and apically, finely and rather densely punctured. Ventral surface of pronotum flat, edges thickened, finely and rugosely punctured; prosternal process prominent, swollen in front of anterior coxae, well developed between them, sulcate on each side of middle, acute and prolonged behind but deflected apically in a broad arc; metasternum with a few minute, widely scattered punctures; pleural sclerities and abdominal sternites more coarsely and densely punc-

tured, becoming even coarser laterally on basal four abdominal sternites; entire ventral surface concolorous with dorsum. Male aedeagus (pl. 5, figs. 35, 36) narrow and elongate; apical sclerite well sclerotized, acutely pointed; basal sclerite strongly curved basally, constricted just behind apical sclerite; penis membranous and indetectable, struts weakly developed. Measurements: length 4.0–4.6 mm.; width 1.9–2.4 mm.

Remarks.—This seemingly rare species is known only from the mountains of southern Arizona. The elongate, comparatively depressed form, the relatively large clypeus which extends backward almost to the eyes, the deep reddish-brown color, the gradually deflexed apex of the prosternal process and the conspicuously punctured, slightly convex elytral intervals should suffice to distinguish *P. inquilinum* from other Nearctic species of *Platydema*. The relatively large male genitalia (pl. 5, figs. 35, 36) indicate no close affinities with other forms studied and its relationships within the genus are not clear. Along with *P. micans*, it apparently represents a wide divergence from the main line of evolution in *Platydema*.

While it is poorly represented in collections it is worthy of note that D. J. and J. N. Knull have accumulated 23 specimens (OSU) from the Chiricahua Mountains. These represent more than half of the total specimens available for this study and suggest that the species is probably much more abundant than we realize. The series is the result of two years' (1952, 1953) collecting, but all were taken in the month of July.

The type series of four specimens was collected by H. G. Hubbard near Tucson, Ariz. (December 23) in nests of a wood rat (*Neotoma albigula*). The specimens collected by the Knulls were all taken under bark, and there probably is no direct association between the beetles and the rodents.

Type.—USNM 4173: Tucson, Ariz., December 23, Hubbard and Schwarz. Three specimens plus one empty pin constitute the type series. All bear type labels but the first example bears Linell's determination label and is to be regarded as the holotype.

Specimens examined.—From the following localities, 41:

United States: Arizona (Baboquivari Mts., Chiricahua Mts., Globe, Patagonia, Pinal Mts., Santa Catalina Mts., Tucson).

Platydema micans Zimmerman

Plate 5 (Figs. 33, 34)

Platydema micans Zimmerman.—Horn, 1870, p. 383.—Blatchley, 1910, p. 1264.

Description.—Short, broadly oval, strongly convex, dark reddish brown to black, shining. Head with epistomal margin evenly

arcuate from eye to eye, clypeus well defined, eyes moderately large, convex, anterior margin broadly and deeply emarginate; separated ventrally by from 1.6 to 2.3 times the longer axis of one eye; terminal segment of maxillary palpus robust, broadly triangular; antennae and mouthparts uniformly dark brown; dorsal surface of head very coarsely and densely, sometimes rugosely punctured. Pronotum transverse, sides strongly and evenly arcuate, convergent from base to apex, apical margin feebly emarginate, basal margin feebly bisinuate; scarcely margined but prominently beaded laterally; both basal and apical angles obtuse, broadly rounded; surface uniformly finely and densely punctured. Elytra narrowly margined and feebly undulate laterally, bead coarse and sharply reflected; discal striae not impressed, punctures coarse and rather widely spaced; outermost stria gradually approaching adjacent one toward base, leaving an unusually large, convex humeral interval between it and elytral margin; scutellar striae absent; remaining striae normal, intervals flat to feebly convex, moderately coarsely and densely punctured; entire dorsal surface with short, microscopic setae arising from punctures. Ventral surface of pronotum slightly concave, smooth; prosternum narrow between coxae, broadly expanded and horizontal caudally, apex acute, unusually deeply inserted into mesosternum; mesosternum prominent with narrowly V-shaped, elevated ridges; metasternum coarsely and densely punctured medially, punctures finer and more widely separated laterally; abdominal sternites densely punctured medially, more coarsely and sparsely so laterally and apically; fourth abdominal sternite always deeply impressed laterally; other sternites sometimes also with lateral impressions. Femora and tibiae concolorous with body, tarsi lighter, yellowish brown. Male aedeagus (pl. 5, figs. 33, 34,) extremely large, apical sclerite comprising only one-fifth the total length of aedeagus; penis prominent, acutely prolonged and moderately well sclerotized apically. Measurements: length 3.4–4.4 mm.; width 1.8–2.6 mm.

Remarks.—This species, frequently credited to Horn, should be assigned to Zimmerman. Horn published the description verbatim from Zimmerman's manuscript after the latter's death, clearly giving him full recognition as author of the species.

Considering the male genitalia alone, this species is probably the most widely divergent member of the genus *Platydema* to be found in the Nearctic region. This divergence is further reflected in the general appearance of the beetle. Superficially it most closely resembles *P. ruficolle*, sharing in common with it, in addition to other characters, the absence of scutellar striae. The abnormally large humeral interstrial elytral interval will immediately separate *P. micans* from

P. ruficolle, and indeed, from all other species of *Platydema* in our fauna.

The nearest modern relative to *P. micans* appears to be *P. inquilinum*, but even this relationship is not especially close and may be but another case of superficial resemblance.

A black light trap operated in 1955 by E. F. Menhinick at Dunwoody, Ga., yielded 474 specimens of this beetle which had previously been considered quite rare. Blatchley (1910) reports taking specimens from decaying fleshy fungi in Lawrence County, Ind. Collection data accompanying specimens examined include: "under rotton wood (Florida); red mangrove (Florida); royal palm (Florida); woods trash (South Carolina)."

Type.—MCZ 7211; type locality, S[outh] C[arolina] (probably from near Zimmerman's home, Columbia). The specimen is now in the LeConte collection.

Specimens examined.—From the following localities, 656:

United States: Alabama (Tuscaloosa). Arkansas (Hope, Washington Co.). California (Los Angeles, in quarantine from Florida). District of Columbia. Florida (Biscayne, Cape Sable, Capron, Daytona Beach, Dunedin, Edgewater, Enterprise, Gainesville, Gulfport, Haulover, Jacksonville, Jupiter, Key Largo, Key West, Lake Worth, Miami Beach, New Smyrna, Oneco, Ormond Beach, Paradise Key, Royal Palm Park, Saint Petersburg, Sand Point, Torreya State Park, Walton, Winter Park, Collier Co., Highlands Co., Volusia Co.). Georgia (Atlanta, Dunwoody). Indiana (Lawrence Co.). Kansas (McPherson). Louisiana (Baton Rouge). Mississippi (Hattiesburg). South Carolina (Florence, Savannah River Plant). Tennessee (East Ridge). Texas (Beeville, Brownsville, College Station, Dallas, Denton, Fort Worth, Goliad, Kingsville, New Braunfels, Sabinal, San Antonio, Sonora, Brazos Co.). Virginia (Norfolk).

Cuba: Cienfuegos.

Jamaica: Liguanea Plain.

Haiti: Ennery.

Mexico: Ciudad del Maíz, Rio Guagalejo, Venodio.

British Guiana: Bartica.

Brazil: Bahia.

Genus *Scaphidema* Redtenbacher

Scaphidema Redtenbacher, 1849, p. 591; 1858, pp. cvi, 603; 1874, pp. cxix, ii, 105.—Mulsant, 1854, p. 200.—Lacordaire, 1859, p. 303.—Thomson, 1859, p. 116; 1864, p. 253.—Jacquelin du Val, 1861, p. 297.—Horn, 1870, p. 386.—Seidlitz, 1875, p. 97; 1891, p. 131; 1894, pp. 508, 509.—Fowler, 1891, p. 15.—Everts, 1901, p. 256.—Desbrochers, 1902, p. 5.—Reitter, 1911a, pp. 330, 339.—Gebien, 1925, p. 143.—Portevin, 1934, p. 25.

Nelites LeConte, 1850, p. 232.

Type species.—*Mycetophagus metallicus* Fabricius (monobasic).

Broadly oval, moderately convex, strongly shining. Head small, short, and broad; eyes small, widely separated both dorsally and ventrally, shallowly emarginate anteriorly; terminal segment of max-

illary palpus elongate oval, truncate apically; antennae clavate, extending but slightly beyond pronotal base, basal segment thick, segments 2 to 4 more slender, segments 5 to 10 slightly transverse, becoming increasingly larger, apical segment large and elliptical. Pronotum with lateral margins almost straight, broadly expanded and reflected, apical margin deeply emarginate, angles acute and prominent; base straight or slightly rounded, angles sharply obtuse. Elytra punctate striate, strongly inflated near lateral margins, particularly at base, lateral margins rather broadly expanded and reflected, humeral angles prominent, smoothly continuous with expanded portion of pronotal margin. Prosternal process broad and spatulate, not prolonged caudally, widely separating front coxae, mesosternum short, flat, broadly U-shaped, widely separating middle coxae, epipleura broad basally, gradually narrowing toward apex, abbreviated near terminal suture of abdominal sternites; first abdominal sternite broad and truncate between hindcoxae, which are widely separated; legs all moderately slender, basal and apical segments of hindtarsi long and subequal, segments two and three very short and subequal. Male aedeagus (pl. 3, figs. 19, 20) with apical sclerite truncate at base dorsally.

The small, shallowly impressed eyes, the stout clavate antennae, the broad spatulate prosternal process, the broad truncate base of the first abdominal sternite between the hindcoxae, the broadly expanded and reflected lateral elytral margins with prominent humeral angles, and the widely separated coxae of all three pairs of legs serve to separate *Scaphidema* from all other genera of Diaperini. Lacordaire (1859) considered this genus to be intermediate between *Neomida* and *Platydema*. Seidlitz (1894) pointed out that in general habitus, *Scaphidema* appears more similar to *Platydema*, but that because of the flattened mesosternum, it is in reality more closely related to *Neomida*. Actually, these other two genera seem to be more closely related, one to the other, than either of them are to *Scaphidema*. Of the two, its closer affinities seem to lie with *Platydema*, although even this relationship is not particularly close.

Seven species of *Scaphidema* are known in the world fauna. Four were described from Japan, one from China, one from Europe, and one from North America. The latter two are the only ones available during the present study.

The European *S. metallicum* (Fabricius), type of the genus, has been well studied. Gebien (1940) lists four synonyms and two varietal names under this species, and the immature stages have been described and figured a number of times (Westwood, 1839, p. 314, fig. 37; Schiødte, 1879, p. 552, tab. 9, figs. 10–16; Seidlitz, 1898, pp. 212, 215; Reitter, 1911a, p. 339, fig. 121).

The North American species is quite similar to the type species. Differences between the two are summarized below under *Scaphidema aeneolum* (LeConte).

As stated earlier, *Scaphidema pictum* Horn has been transferred to the Phaleriini (Triplehorn, 1961). Because of homonymy involved in this transfer, it is now called *Phaleromela variegata* Triplehorn.

Scaphidema aeneolum (LeConte)

PLATES 2 (FIG. 12), 3 (FIG. 20)

Nelites aeneolus LeConte, 1850, p. 232.
Scaphidema aeneolum (LeConte).—Horn, 1870, p. 386.—Blatchley, 1910, p. 1265.

DESCRIPTION.—Elongate oval, strongly convex, greenish bronze to black, strongly shining. Head very short in front of eyes, clypeus very short but broad, poorly defined, epistomal margin feebly rounded; genae slightly reflected above antennal insertions, entire head surface evenly convex, coarsely and densely punctured. Pronotum almost twice as broad as long, convex, lateral margins straight and parallel except near apex where they are sharply rounded; surface deeply, coarsely, but sparsely, punctured. Elytra with lateral margins feebly arcuate, gradually attenuate apically; striae finely and closely punctured, very feebly impressed; intervals subconvex, usually with a few widely spaced minute punctures forming irregular series on each interval. Ventral surface of pronotum with a few moderately coarse punctures near middle, faintly wrinkled posteriorly and near front coxal cavities; prosternum with coarse, dense punctures along anterior margin, prosternal process broad, slightly concave between coxae, its apex truncate and deflected; mesosternum flattened and practically smooth; metasternum smooth except for an elongate group of coarse punctures extending from middle coxal cavities to the anteriolateral edge of hindcoxal cavities; pleural sclerites rather coarsely and densely punctured; epipleura distinctly but irregularly punctured; abdominal sternites finely and sparsely punctulate medially, each with distinct lateral impressions within and beyond which the punctures are much coarser; hindtarsi long, basal and apical segments subequal in length. Male aedeagus (pl. 3, fig. 20) with apical sclerite 0.6 as long as basal sclerite, its base truncate. Measurements: length 3.3–4.7 mm.; width 1.6–2.5 mm.

REMARKS.—The European *S. metallicum* (Fabricius) is much more broadly oval than *S. aeneolum* and has the sides of the pronotum straighter and more rapidly convergent anteriorly. The male aedeagus (pl. 3, fig. 19) is much more elongate and less attenuate apically than in its North American relative. In addition, there are a number of relative but nevertheless taxonomically useful differences between them. *S. metallicum* usually has the elytral

striae more finely punctured and not at all impressed, the prosternum lacks the coarse punctures along the anterior margin and the elytra are more convex and inflated basolaterally.

S. aeneolum is strictly a boreal species. It has been taken from under bark of *Pinus ponderosa* and *Picea glauca*. A series of 24 specimens from Duparquet, Quebec, was taken from lake drift by G. Stace Smith from May 24 to June 27. Adults have been collected in the field solely from May 15 (Plummer, Minn.) to September 30 (Cornwall, Conn.).

TYPE.—MCZ 4694. The specimen bears a light blue "Lake Superior" label which was listed by LeConte as "Pic to Ft. William." The LeConte collection contains three additional specimens with identical labels and one specimen with a yellow "Western States" label.

SPECIMENS EXAMINED.—From the following localities, 118.

United States: Alaska (Eagle). Connecticut (Cornwall). Illinois (Chicago). Michigan (Detroit, Marquette). Minnesota (Plummer). New Hampshire (Mount Washington). New York (Catskill Mts., DeBruce, Mount MacIntyre, Oliverea, Redford, Saranac, Schenectady, West Point). Pennsylvania (Mount Pocono). Wyoming (Grand Tetons, Jenny Lake).

Canada: Alberta (Edmonton). British Columbia (Cariboo District, Golden, King Creek, McBride, Merritt). Labrador (Goose Bay). Manitoba (Aweme). New Brunswick (River Glade). Ontario (Isle Royale, Michipicoten River). Quebec (Cascapedia River, Duparquet, Kazubazua, Laniel).

Genus *Liodema* Horn

Liodema Horn, 1870 p. 385.—Bates, 1873b, p. 235.—Champion, 1886, p. 205.

TYPE SPECIES.—*Platydema laevis* Haldeman (monobasic).

Broadly oval, strongly and uniformly convex, moderately shining. Head deeply inserted into thorax, concealing posterior margin of eyes; clypeus large, well defined, rounded posteriorly, extending almost to eyes; eyes large, deeply emarginate anteriorly, entire dorsal periphery sunken below surface level of head; antennae with segments 4 to 10 more or less serrate along inner margin. Pronotum smooth, extremely minutely punctulate, narrowly embracing humeral angles of elytra at base. Elytra smooth, striae unimpressed, very minutely punctulate, intervals flat, punctures sparse and visible only at high magnification. Ventral surface moderately shining, finely and sparsely punctured, metasternum entirely smooth laterally; epipleura broad and concave at base, well defined and broadly continued to apex of elytra; prosternal process broad between coxae, expanded laterally to embrace coxae posteriorly, prolonged medially to the acute apex; mesosternum forming prominent, apically rounded lobe which extends forward, concealing prosternum in repose (pl. 3, fig. 14); tibiae straight, moderately expanded apically, terminating in a comb-

like crown of short spinules; tarsi relatively long, hindpair nearly as long as their tibiae; basal segment of hindtarsus longer than following two segments combined.

This genus was erected by Horn to receive the single species *Platydema laevis* Haldeman. His only criterion for its separation from *Platydema* is in the structure of the mesosternum and its relation to the prosternum, a diagnosis which in itself is quite adequate. Bates (1873b) added to the generic description the facts that the antennae are more or less serrate at their inner edges and that the epipleura are entire. In addition, he described six species from South America. Between 1877 and 1878, Chevrolat described seven South American species which have subsequently been referred to *Liodema*. Three of these were originally placed in the genus *Platydema*, three in *Scaphidema*, and only one in *Liodema*. Chevrolat himself transferred these species plus one species of *Platydema*, described by Laporte and Brullé, to *Liodema*, casting two of his own species into synonymy with two of Bates'. Champion (1886) placed four species described by Chevrolat, one by Laporte and Brullé, and one by Bates as synonyms of other recognized forms, at the same time adding two new species from Central America. Gebien (1906, p. 219), upon examination of the Fabrician types in Copenhagen, discovered that *Mycetophagus maculatum* Fabricius is actually a *Liodema*. In his 1940 checklist, Gebien recognizes 12 species of *Liodema* in the world fauna, summarizing our knowledge of the genus to date.

It is quite possible that a number of species described by older authors in the genus *Platydema* will eventually be found to belong here. In general habitus, there is a striking resemblance between the two genera except for the peculiar development of the mesosternum in *Liodema*, a character which is often obscured in the mounting process, particularly in older collections.

The distribution of *Liodema* is almost entirely Neotropical, with only one species occurring north of the Rio Grande. Several of these (e.g., *L. obydense* Bates) are widespread, occurring from Mexico, throughout Central America, and well into Brazil.

Liodema laeve (Haldeman)

Plate 3 (Figs. 13, 14)

Platydema laevis Haldeman, 1848, p. 101.
Liodema laeve (Haldeman).—Horn, 1870, p. 385.—Champion, 1886, p. 205.

Description.—Broadly oval, strongly convex, dark brown to black, smooth, moderately shining. Head reddish in front of eyes, black posteriorly, surface minutely and rather densely punctulate; eyes large, flattened dorsally; antennae, labrum, mouthparts and legs

light reddish brown, terminal segment of maxillary palpus narrowly triangular, outer margin strongly oblique. Pronotum dark brown or black with apex and basolateral edges gradually lighter; lateral margins arcuate, finely beaded, very strongly converging from base to apex; apex feebly emarginate, base strongly bisinuate; apical angles broadly rounded and deflected, basal angles obtuse; surface smooth, very minutely but rather densely punctulate. Elytra dark with considerable portion of apex and sometimes a faint sutural stripe lighter; lateral margins very narrowly margined and beaded; surface minutely striato-punctulate, intervals flat, punctures extremely minute. Ventral surface, including epipleura, reddish brown, shining, finely and sparsely punctate with lateral areas of metasternum, pleural sclerites and ventral surface of pronotum perfectly smooth. Mesosternum (pl. 3, fig. 14) broad, spatulate, finely and rugosely punctate. Male aedeagus with apical sclerite small, much narrower at base than basal sclerite; penis struts fused for a portion of their length and rather heavily sclerotized (pl. 3, fig. 15). Measurements: length 3.7–4.4 mm.; width 2.4–2.5 mm.

Remarks.—This is the only species of *Liodema* which has been found in the United States. It is easily the most prosaic member of the genus, distinct among its congeners in its somber coloration. All of the other described species are banded or spotted in various shades of red and yellow.

Champion (1886, p. 205) records this species from Mexico (Jalapa) and Guatamala (Capetillo), but did not see any examples from the United States. A series of five specimens labelled "Mexico, May, 1934"(CU) has been studied, and these were found to differ considerably from American specimens in the following respects: They are quite dull in lustre, the punctures of the elytral striae are much larger and more conspicuous, there is no light area at the apex of the elytra, and the apical sclerite of the male aedeagus is relatively shorter. Until further specimens with more detailed data become available, it is best to postpone description of a new species; meanwhile, the two Central American localities must be considered of doubtful validity.

Type.—MCZ 8372. Bears an orange "Southern States" label but according to the description is from "Carolina" (collected by Zimmerman). Most of the ventral surface of the specimen is obscured by glue, but the mesosternum and other salient features are quite evident.

Specimens examined.—From the following localities, 10:

United States: Florida (Brooksville, Jan. 27, 1940, Crescent City, March 27, 1896, H. G. Hubbard). Georgia (Dunwoody (light trap)). North Carolina. Texas.

Genus *Apsida* Lacordaire

Apsida Lacordaire, 1859, p. 309.—Bates, 1873c, p. 15.
Hapsida Champion, 1886, p. 211.

Moderate to large, robust, strongly convex, shining. Head short and broad; clypeus transversely very broad, not prolonged beyond genae, epistomal margin broadly and feebly emarginate or truncate on level with antennal insertions; eyes rather small, narrow, widely separated both dorsally and ventrally; broadly emarginate anteriorly; terminal segment of maxillary palpus broadly triangular with outer angle strongly produced; terminal five antennal segments abruptly expanded to form rather compact, flattened club. Prosternal process broad and robust between anterior coxae, its apex obtuse, slightly prolonged and broadly rounded behind, sometimes slightly declivitous; mesosternum short, prominently notched anteriorly for reception of prosternum; epipleura broad, abruptly abbreviated at or near last ventral abdominal suture; legs moderately long, femora compressed, slightly claviform, tibiae distinctly bowed; basal segment of hindtarsus half again as long as following two segments combined and subequal to fourth.

Type species.—*Apsida chrysomelina* Lacordaire, 1859, p. 309 (by original designation).

The abruptly 5-segmented club, broad but short clypeus which is not prolonged beyond genae, and the abbreviated epipleura will, in combination, separate *Apsida* from all other New World genera of Diaperini. Its Asiatic counterpart is *Hemicera* Laporte and Brullé, whose members closely resemble our Central American species of *Apsida*, differing primarily in having the antennal club composed of six rather than five segments.

This genus, briefly but adequately delimited by Lacordaire, was erected to receive the single species *Apsida chrysomelina* Lacordaire. His original description is merely a brief summary of characters which separate *Apsida*, an exclusively neotropical genus, from the Old World genus *Hemicera*. Bates (1873c) presented a detailed redescription of the genus and added four more species. Chevrolat (1877a) described two more species, but these were later placed in synonymy by Champion (1886) who, at the same time, added four more species of his own. At least nine species are represented in the World fauna.

A wide variation in color, form, and structure exists among species of this genus and affords useful characters for their separation. Coloration varies from the yellowish *A. boucardi* Bates to the uniformly dark *A. gibbosa* Champion. Many species have a series of

iridescent reddish, greenish, and golden stripes and blotches on the elytra which appear to be evanescent and should not be relied upon too heavily as an important taxonomic character, as was done by Bates.

The shape of the pronotum varies from the elongate form with straight sides, prominent apical angles, and deeply emarginate anterior margin as in *A. chrysomelina* Lacordaire and *A. gibbosa* Champion, to the short, more transverse form with rounded sides and apical angles as in *A. belti* Bates and *A. purpureomicans* Bates.

The punctures forming the elytral striae and the relative size and abundance of the punctures of the elytral intervals are constant enough within a species to be taxonomically useful, as are the microreticulations and consequent intensity of the surface lustre of the elytra.

The form and sculpture of both the prosternal process and the mesosternum likewise may prove constant enough to be of value.

Unlike most Diaperini, members of this genus apparently are not associated with fungi. Champion states that the Central American forms are found "upon herbage or by beating the withered, still-attached leaves of fallen trees in new clearings."

In attempting to establish the identify of the one species of *Apsida* which has been found north of the Rio Grande, a moderate series of specimens from various sources was accumulated. Through the generous efforts of Mr. J. Balfour-Browne of the British Museum, it was possible to borrow cotypes of all but one of Champion's species and to have specimens compared with those of Bates.

The most confusing element in understanding the components of this genus is the status of *A. purpureomicans*, a widely distributed, evidently polymorphic species, which Champion refers to as "one of the most perplexing species of Tenebrionidae I have yet had to deal with." He was able to recognize three distinct varieties, separated entirely on coloration and dorsal surface lustre. To further cloud the issue, there is a smaller species (*A. terebrans* Champion) which apparently falls well within the range of variation exhibited by *A. purpureomicans* and which has been taken in several localities in company with it. The male aedeagus of *A. terebrans* is deeply cleft apically and quite distinct from any other known species in the genus. In all other species studied, the form of the aedeagus is not at all diagnostic. Until more specimens of this complex can be studied, it seems best to defer any comprehensive review of this genus, since it is impossible at this time to add any consequential information beyond what Champion has already contributed.

Apsida belti Bates

PLATES 6 (FIGS. 49, 50, 51), 7 (FIG. 65)

Apsida belti Bates, 1873c, p. 16.
Hapsida belti Champion, 1886, p. 213; 1893, p. 539.
Hapsida purpureo-micans Bates.—Schaeffer, 1905, p. 174 [misidentification].

DESCRIPTION.—Elongate oval to broadly oval, strongly convex, dark shining. Head dark brown to almost black, epistomal margin broadly but very shallowly emarginate; eyes narrow, shallowly and broadly emarginate anteriorly, dorsal margin narrowly rounded, not at all angulate medially; head surface finely and very sparsely punctulate. Pronotum twice as broad as long, widest at base, apex deeply and evenly arcuate, base broadly rounded, slightly produced in region of scutellum; lateral margins rather strongly arcuate, strongly convergent toward apex, bead well developed and abruptly reflected, both basal and apical angles slightly abtuse, narrowly rounded, entire surface dark brown to almost black, very minutely and sparsely punctulate. Elytra dark with red, gold, and green iridescent stripes and blotches, lateral margins broadly rounded to subparallel, narrowly and horizontally expanded, feebly beaded; striae not impressed, composed of fine, widely spaced punctures which becomes obsolete laterally, basally and apically; intervals minutely but distinctly reticulate, with a few very minute, widely scattered punctures. Ventral surface of pronotum feebly concave, perfectly smooth; prosternal process broad, blunt apically and prominently grooved on each side of middle; mesosternum deeply and angularly notched in front, inner portion depressed, leaving margins standing in bold relief as a distinct M-shaped configuration; metasternum, pleural sclerites and abdominal sternites all smooth and shining with minute pattern of reticulations. Male aedeagus (pl. 6, figs. 50, 51) with lateral lobes fused but individually distinct, prolonged and acute apically. Measurements: length 6.1–7.6 mm.; width 3.5–4.4 mm.

REMARKS.—In 1905, Charles Schaeffer reported specimens of an *Apsida* taken near Brownsville, Tex., on dead branches of *Acacia flexicaulis*. These he referred to Champion's "variety three" of *A. purpureomicans* Bates, a polymorphic species which is poorly understood taxonomically.

Two of Schaeffer's specimens from Brownsville were submitted to J. Balfour-Browne for comparison with the Bates type in the British Museum. It is his opinion that they should be referred to *A. belti* Bates, rather than to *A. purpureomicans*, primarily on the basis of the microreticulations on the elytra which causes a duller lustre in the former species. This character is variable but

quite reliable within limits. In all of the Texas specimens, three specimens from Costa Rica (USNM), and the type from Nicaragua, a definite pattern of these microreticulations is clearly evident over the entire elytra even at moderate magnifications. In the specimens of *A. purpureomicans* available for study from several localities in Central America, the microreticulations are entirely absent or so very obsolete as to be scarcely evident even at high magnifications. The type of *A. purpureomicans* is without reticulations, as are most of Champion's specimens (Balfour-Browne, in litt.).

The Nicaragua specimens (fide Bates) and those from Costa Rica (USNM) are slightly larger than any from Texas, and in most of the latter, the elytral margins are more parallel. Otherwise they are indistinguishable.

TYPE.—Not seen; material compared with type in British Museum by J. Balfour-Browne; type locality, Chontales, Nicaragua (3 specimens). Lectotype not selected.

SPECIMENS EXAMINED.—From the following localities, 22:

United States: Texas (Brownsville).
Costa Rica: El Limón, Santa Clara, Hamburg Farm, Reventazón River.

Genus *Alphitophagus* Stephens

Alphitophagus Stephens, 1832, p. 12.—Redtenbacher, 1858, pp. cvi, 602; 1874, pp. ii, cxviii, 106.—Lacordaire, 1859, p. 306.—Thomson, 1859, p. 116; 1864, p. 254.—Jacquelin du Val, 1861, p. 298.—Horn, 1870, p. 385.—Seidlitz, 1875, p. 97; 1891, p. 131; 1898, pp. 212, 215 (larva), 509, 533.—Fowler, 1891, p. 16.—Desbrochers, 1902, p. 12.—Everts, 1901, p. 258.—Reitter, 1911a, pp. 330, 340; 1911b, p. 268.—Kuhnt, 1913, pp. 740, 746.—Portevin, 1934, pp. 24, 25.

Phyletes Redtenbacher, 1845, p. 128; 1849, p. 52.

Phylethus Redtenbacher, 1849, p. 589.—Mulsant, 1854, p. 203.—LeConte and Horn, 1883, p. 383.

Alphitobius [error for *Alphitophagus*], Reitter, 1914, p. 81.

TYPE SPECIES.—*Diaperis bifasciata* Say (= *Alphitophagus quadripustulatus* Stephens) (monobasic).

Elongate oval, moderately convex, shining; entire dorsal surface uniformly clothed with fine but distinct, light colored, short, recumbent setae arising from rather widely spaced, minute punctures. Antennae long, extending well beyond base of pronotum, stout; basal segment robust, sharply curved outwardly, second segment small, third and fourth subequal in length and slightly elongate, segments 5–10 gradually broader, each distinctly transverse apically, terminal segment largest, subconical; maxillary palpi extremely narrow basally, terminal segment thickened, elongate oval, obliquely truncate api-

cally. Prosternal process narrow, convex between coxae, its apex acute and secondarily reflected; epipleura entire, very narrow at apex; tibiae all slender, tarsi relatively long, hindtarsus with basal segment the longest but only slightly longer than fourth.

The above description has been purposely kept brief since only one species of the genus (fortunately the type species) has been studied, rendering it difficult to establish generic limits with any certainty. This species resembles a small *Platydema* in general appearance, but may be distinguished from members of the latter genus by the distinct vestiture of fine recumbent setae clothing the entire dorsal surfaces. The antennae are longer and more slender than is true of most species of *Platydema*, and the terminal segment of the maxillary palpus is elongate. Both of these characters, however, fall well within the range of variation observed among species of *Platydema*.

Gebien (1940) lists eight species of *Alphitophagus* in the world fauna. No less than six of these have the same general color pattern, and it would not be surprising to discover some synonymy involved among these names. It is possible that the system of coloration should be listed among the generic characters, but this has resulted in confusion in the past. Marseul (1876) described four species which he placed in *Alphitophagus*, partly, at least, because of the color pattern. Three of these have been transferred to *Platydema* by subsequent workers and the fourth is retained somewhat doubtfully in *Alphitophagus* (Gebien, 1940).

The peculiar development of the male clypeus described below perhaps deserves consideration as a generic character, but its status is unknown in other members of the genus. As far as can be determined, it has no counterpart in *Platydema* or related genera. Until further information is available, it seems advisable to reserve judgment on this character. Thus it can be seen that in the final analysis, the genus *Alphitophagus* is retained as distinct from *Platydema* on the basis of but one rather poor criterion—the dorsal vestiture. There are too many gaps in our knowledge of either of these genera on a worldwide basis to justify lumping them together, so the present distinction is herein retained. Considering only the Nearctic and Palaearctic fauna, this appears to be quite valid, and will suffice for the present treatment.

Alphitophagus bifasciatus (Say)

PLATE 6 (FIGS. 55, 56, 57)

Diaperis bifasciata Say, 1824, p. 268.

Alphitophagus quadripustulatus Stephens, 1832, p. 12, pl. 24, fig. 1.—Redtenbacher, 1858, p. 603; 1874, p. 107.—Jacquelin du Val, 1861, p. 299, tab. 73, fig. 363.—Thomson, 1864, p. 255.—Seidlitz, 1875, p. 362; 1891, p. 517, p. 554;

1898 [often cited as 1894], p. 534.—Baudi, 1876b, p. 106; 1876a, p. 229.—Fowler, 1891, p. 16.—Schilsky, 1893, p. 355.—Desbrochers, 1902, p. 12.
Diaperis picta Ménétriés, 1832, p. 203.—Mäklin, 1872, p. 247.
Neomida picta (Ménétriés).—Faldermann, 1837, p. 65.
Platydema bifasciatus (Say).—Haldeman, 1848, p. 102.
Phylethus populi Redtenbacher, 1849, p. 589.
Phylethus quadripustulatus (Stephens).—Mulsant, 1854, p. 204.—Schiødte, 1879, pp. 555, 586, tab. 9, figs. 17–27.
Platydema pictum (Ménétriés).—Gemminger and Harold, 1869, p. 1952.
Alphitophagus bifasciatus (Say).—Horn, 1870, p. 385.—Fauvel, 1889, p. 155.—Hamilton, 1890, p. 43.—Heyden, 1890, p. 132.—Champion, 1895, p. 283.—Everts, 1901, p. 258; 1922, p. 376.—Reitter, 1911a, p. 340, tab. 128, fig. 23; 1911b, p. 268.—Kuhnt, 1913, p. 746, fig. 67.—Chittenden, 1917, p. 282.—Back and Cotton, 1922, p. 39, fig. 58; 1938, p. 36; 1953, p. 36, fig. 50; 1955, p. 36, fig. 50.—Zacher, 1927, p. 113, tab. 4, fig. 18.—Portevin, 1934, p. 26, fig. 51.—Cotton, 1941, p. 39, fig. 35; 1950, p. 39, fig. 35; 1956, p. 65, fig. 48.—Daggy, 1946, p. 254.
Alphitophagus picta (Ménétriés).—Faust, 1875, p. 251.
Phylethus bifasciatus (Say).—Blatchley, 1910, p. 1265.
Alphitobius (lap. cal.) *quadripustulatus* (Stephens).—Reitter, 1914, p. 81.
Alphitophagus bifasciatus Say aber. *unifasciatus* Donisthorpe, 1925, p. 115.
Alphitophagus quadripustulatus Stephens ssp. *judaeus* Roubal, 1929, p. 97.

Description.—Elongate oval, light reddish brown dorsally with two dark, transverse bands on elytra, shining. Head of male (pl. 6, fig. 57) peculiarly sculptured as follows: clypeus greatly swollen, reflected, grooved dorsally on each side for reception of genae which are prolonged in front of eyes and above antennal insertions to form prominent, flattened, slightly recurved tubercles; two longitudinal, parallel, carinate ridges extending from middle of frons to epistomal suture; surface finely and densely punctulate. Head of female simple, clypeus prolonged in front, genae slightly raised above antennal insertions; surface coarsely and densely punctured. In both sexes, antennae, mouthparts, and legs yellowish; eyes large, convex, broadly but shallowly emarginate anteriorly, posterior margin abruptly elevated. Pronotum reddish, sometimes with obscure dark mottling, slightly more than 1½ times as broad as long, sides strongly arcuate, widest just anterior to middle, finely beaded, apical margin truncate, base broadly and feebly bisinuate, both basal and apical angles obtuse, apical angles broadly rounded, basal angles rectangular; surface rather coarsely and densely punctured. Elytra reddish, a considerable portion of base, a median and subapical transverse band black, these often connected by a more or less complete sutural stripe of the same color; scutellum reddish; striae scarcely impressed, finely and distantly punctured; intervals subconvex to flat, minutely but rather densely punctulate, each puncture bearing a minute seta. Ventral surface of pronotum thickened, coarsely and shallowly punctured; mesosterna, metasterna, pleura, and first four abdominal segments

coarsely and densely punctured; terminal two abdominal sternites with sparse, very fine punctures, each of which bears a fine seta. Male aedeagus (pl. 6, fig. 55) with massive, heavily sclerotized struts extending well beyond basal sclerite; lateral lobes narrow, feebly sclerotized except at base, acutely pointed and slightly divergent apically; penis with a pair of heavily sclerotized basolateral processes which protrude laterally when penis is everted (pl. 6, fig. 56). Measurements: length 2.2–3.1 mm.; width 1.0–1.4 mm.

REMARKS.—The color pattern consisting of two dark elytral crossbands against a reddish-brown ground color, the vestiture of fine setae clothing the dorsal surface, and the distinctive development of the male clypeus separates this species from its relatives.

Neither Say nor Stephens mentioned the male clypeus, which leads one to suspect that they had only females before them. It was Jacquelin du Val (1861) who first alluded to this character.

The species was well known for many years both in the United States and in Europe, the only point of confusion being in the name. Almost every faunal list contains a reference to it under any one of about a dozen names. A number of fine illustrations, many of them in color, are available, notably those of Stephens (1832), Reitter (1911a), Zacher (1927), Back and Cotton (1922, 1953, 1955) and Cotton (1941, 1950, 1956). The immature stages are figured by Schiødte (1879). Many notes on the biology and economic importance have appeared and are nicely summarized by Chittenden (1917).

Horn (1870) was apparently the first to use the name in its present combination. *Phyletes* and *Phylethus* of Redtenbacher are direct synonyms which were later (Redtenbacher, 1858) refuted by the author himself, along with his trivial name, *populi*.

The color pattern is constant enough to be quite reliable, but occasionally specimens are encountered in which the two dark elytral crossbands are united, leaving the elytra black except for an uninterrupted light crossband near the base. It is this phase that was called "aberration *unifasciatus*" by Donisthorpe (1925). At the other extreme in pigmentation are teneral examples in which the entire pattern is more or less obliterated, of which *Alphitobius* [sic] *quadripustulatus* Stephens *judaeus* Roubal (1929), based on a single male, should prove to be an example.

A survey of the literature indicates that *A. bifasciatus* is primarily fungivorous and may be found out-of-doors under bark, in decaying vegetable matter, and other debris in natural situations. It may become locally abundant in granaries, mills, warehouses, stables, and other places where spoiled grain is allowed to accumulate and mold. In no instance has it been actually observed attacking sound grain or freshly milled products (Chittenden, 1917). It has been suc-

cessfully reared on moist cornmeal and spoiled cereals (Cotton, 1941). Schuster (1946) reports that it is "one of the most frequently. present and abundant tertiary pests (in stored grain and cereals) in New York [State]."

The origin of this species is unknown. Champion (1895) considered it to be American, basing his assumption on its having been originally described by Say from this country.

TYPES.—None seen. Say's *Diaperis bifasciata* was collected at "Engineer Cantonment." The first specimens of *Alphitophagus quadripustulatus* that Stephens saw were reared on flour; later, he acquired a large series from Cambridge, England. *D. picta* was described by Ménétriés from the Caucasus and Redtenbacher's *populi* from Austria. The aberration *unifasciatus* Donisthorpe was collected at Burwell Fen, England, and Roubal's subspecies *judaeus* came from Palestine.

SPECIMENS EXAMINED.—From the following localities, 412:

United States: Arkansas (Mount Sequoyah). California (Chino, Echo Mt., El Mirador, Hanford, Kaweah, Mokelumne, Hill, Morgan Hill, Pasadena, Santa Ynez, Stockton, Woodlake, Kern Co., Sonoma Co.). District of Columbia. Georgia (Atlanta). Idaho (Coeur D'Alene, Hansen). Illinois (Thomasboro, Urbana). Indiana (Hovey Lake, Lawrence Co., Marion Co., Rush Co., Starke Co., Vigo Co.). Iowa (Ames, Fairfield, Fernald, Fort Madison, Greenfield, McCallsburg, Menlo, Nevada, Panora, Peru, Shelby, Stockport, Wapello, Washington, Wilton, Winterset, Clinton Co., Ida Co., Madison Co., Monona Co., Sac Co., Story Co., Wright Co.). Kansas (Lawrence, McPherson, Onaga, Topeka, Wellington, Kingman Co., Labette Co., Stafford Co.). Maryland (Lakeland). Minnesota (Mankato, Saint Paul). Missouri (Columbia, Fulton, Saint Charles). Nebraska (Central City, Wauneta). New Jersey (Boonton). New York (Brooklyn, Dansville, Ithaca, Springfield). North Carolina (Black Mts.). Ohio (Champaign Co.). Oregon (Adams, Condon, Corvallis, Dallas, Forest Grove, Hood River, Independence, McMinnville, Pendleton). Pennsylvania (Easton, Jeannette, Pittsburgh, Wyoming, Allegheny Co., Washington Co.). South Dakota (Brookings, Elk Point, Highmore, Revillo, Vermillion). Tennessee. Texas (Fuller). Virginia (Fredericksburg). Washington (Perry).

Canada: Ontario (Chatham, Keewatin).

Genus *Pentaphyllus* Dejean

Pentaphyllus Dejean, 1821, p. 68.—Latreille, 1829, p. 30.—Redtenbacher, 1845, p. 128; 1849, pp. 52, 589; 1858, pp. cvi, 602; 1874, pp. cxviii, ii, 107.—Mulsant, 1854, p. 196.—Lacordaire, 1859, p. 312.—Thomson, 1859, p. 116; 1864, p. 256.—Jacquelin du Val, 1861. p. 299.—Horn, 1870, p. 378.—Seidlitz, 1875, p. 96; 1891, p. 132; 1894, pp. 509, 536.—Desbrochers, 1901, p. 187.—Everts, 1901, p. 258.—Blatchley, 1910, p. 1265.—Reitter, 1911a, pp. 330, 340.—Kuhnt, 1913, pp. 740, 746.—Chatanay, 1914, p. 475.—Gebien, 1925, pp. 120, 142.—Portevin, 1934, p. 26.

Iphicorynus Jacquelin du Val, 1861, p. 299.

TYPE SPECIES.—*Mycetophagus testaceus* Hellwig (1792, p. 400). Designated as *M. testaceus* Gyllenhal (1813, p. 401) by Chevrolat, 1847, in D'Orbigny's "Dictionnaire universel d'histoire naturelle" (vol. 9, p. 573). Gyllenhal himself credited the species to Hellwig; Chevrolat and several other earlier workers were incorrect in assigning it to Gyllenhal.

Small, oblong oval, pale reddish brown, shining. Head short, eyes globose, small (in North American species) to very large, anterior margin entire; terminal segment of maxillary palpus thickened, oval, outer angle attenuate, apex truncate; antennae short, extending only to about middle of prothorax, terminal five segments abruptly expanded to form loose club. Pronotum transverse. Elytra rather short, convex, sides subparallel, lateral margins narrowly expanded, strongly reflected, prominently beaded; surface estriate, coarsely, shallowly, and densely punctured. Entire dorsal surface clothed with short, very fine, yellowish setae, each arising from a puncture. Epipleura abbreviated.

The abruptly expanded, 5-segmented antennal club, the estriate and confusedly punctured elytra clothed with fine yellowish setae, and the entire anterior margins of the eyes are, in combination, sufficient to distinguish *Pentaphyllus* from all other genera in the tribe.

The name *Pentaphyllus* was first coined by Mégerle who cannot receive credit for it because it was published in a sales catalog. Dejean (1821) adopted the name in his catalog and validated it by including *P. testaceus* (Hellwig) as one of its members. Thus Dejean receives the authorship of the generic name, not Latreille, who published 8 years later and did not include a single species.

Pentaphyllus is worldwide in distribution. Gebien (1940) lists 31 species in the world fauna, most of which appear to be valid. Only the two European species, *P. testaceus* (Hellwig) and *P. chrysomeloides* (Rossi), are at all well known.

The genus *Iphicorynus* was erected by Jacquelin du Val for *P. chrysomeloides*. This division is not without considerable merit, since all of his characters do, in fact, distinguish this species from the type species which agrees quite well with our two North American forms. In *P. chrysomeloides*, the epipleura are abruptly abbreviated at a considerable distance from the apices of the elytra, the tibiae are all slightly expanded apically, the first segment of the hindtarsus is shorter than the two following combined and notably shorter than the last, and the eyes are large and narrowly separated ventrally. However, since it falls well within the generic limits as defined above, it shall be considered a member of *Penta-*

phyllus until a broader study of the Old World components can be undertaken.

The insect from Atlanta, Ga., described as *P. americanus* by Motschoulsky, is unrecognizable. It is smaller then either of our two known species and probably represents some other genus, perhaps even another family such as Ciidae, to which members of this genus bear a striking resemblance. A. Zhelokovtsev (UMMZ) reports that all that remains of the type is the pin, the specimen itself having been lost.

Key to North American Species of *Pentaphyllus*

1. Lateral margins of pronotum not at all expanded; frons of male with two distinct median tubercles; northeastern North America . . **pallidus** LeConte
   Lateral margins of pronotum distinctly expanded; frontal tubercles absent in both sexes; known only from California . . . . **californicus** Horn

Pentaphyllus pallidus **LeConte**

Plate 3 (Figs. 16, 17)

Pentaphyllus pallidus LeConte, 1866, p. 126.—Horn, 1870, p. 387.—Hamilton, 1895, p. 373.—Blatchley, 1910, p. 1265.

Description.—Oblong oval, strongly convex, pale reddish brown, shining. Head with clypeus well defined, prolonged beyond genae, anterior margin arcuate; genae rounded, slightly raised above antennal insertions; frons evenly convex; male with two short but prominent, sharply pointed, widely separated tubercles on frons between eyes and in line with lateral margins of clypeus; head of female unarmed; eyes very small, widely separated both dorsally and ventrally; surface coarsely and densely punctured. Pronotum 1.5 times as broad as long, widest near middle, lateral margins feebly rounded, slightly convergent anteriorly, not at all expanded, finely beaded; apical margin truncate, base nearly straight with lateral portions broadly expanded, thin and overlapping bases of elytra, slightly reflected in front of scutellum; both basal and apical angles obtuse and broadly rounded; entire surface coarsely, shallowly, and rather densely punctured. Elytra with lateral margins parallel, abruptly attenuate and declivitous behind; surface coarsely, shallowly, uniformly, and densely punctured. Scutellum relatively large, broadly triangular, sparsely punctulate. Ventral surface of pronotum concave, smooth; prosternal process narrow between coxae, grooved medially, slightly deflected behind, apex prolonged caudally, acutely pointed, prominent; mesosternum flat, not forming V-shaped ridge in front of mesocoxae; remainder of ventral surface very coarsely and densely punctured, concolorous with dorsum; tibiae all slender; hindtarsus with basal

segment slightly longer than two following combined and subequal to fourth; epipleura gradually narrowed, almost attaining apices of elytra. Aedeagus of male relatively narrow and elongate (pl. 3, fig. 17). Measurements: length 1.9–2.4 mm.; width 0.9–1.2 mm.

Remarks.—The two North American species of *Pentaphyllus* are very similar in appearance and difficult to characterize individually. *P. pallidus* may be separated from *P. californicus*, in addition to the characters presented in the key, by its relatively shorter and more convex body and the less robust aedeagus of the male (pl. 3, fig. 17). The species occupy widely separated ranges.

LeConte (1866) in his description of *P. pallidus* states that it "differs from that species (*P. testaceus* (Hellwig)) by the body beneath being not black, but of the same color as the upper surface." This is an inconstant character. Specimens of both species have been studied in which the ventral surface is totally or in part black. Most specimens studied had both surfaces of the same color. Only eight specimens of *P. testaceus* have been seen. They have the short, robust body of *P. pallidus* but have the lateral margins of the pronotum even more broadly expanded and reflected than in *P. californicus*. The dorsal vestiture of fine pale setae in *P. testaceus* is at least twice as long as in either of the North American species and is quite conspicuous, even at low magnification. Since specimens were not available for dissection, it is not known whether or not the male genitalia might prove diagnostic.

Horn (1870) was the first to call attention to the frontal tubercles of the male. Otherwise, he merely repeats the remarks of LeConte and states that it is "Abundant in Canada West." Blatchley (1910) collected this species by sifting the debris of beech and maple stumps. It is probably much more abundant than available cabinet material would indicate. Hamilton (1895) took as many as 30 specimens from under bark of elm in southwestern Pennsylvania.

Type.—MCZ 4701, female. Bears a pink "Southern States" label, but according to the original description, it is from Pennsylvania. The ventral surface of the specimen is embedded in glue, but the diagnostic characters are all clearly visible. Also in the LeConte collection are 1 male and 2 females labelled "Can[ada]."

Specimens examined.—From the following localities, 57:

United States: Connecticut (Cornwall). Illinois. Indiana (Dubois Co., Marion Co., Monroe Co., Spencer Co.). Kentucky (Edmonton). Maryland (Riverdale). Michigan (Detroit, Grand Ledge). New Jersey (Berkeley Heights). Ohio (Cincinnati). Pennsylvania (Jeannette, Pittsburgh).

Canada: Ontario, (Grimsby, Leamington).

Pentaphyllus californicus Horn

PLATE 3 (FIG. 18)

Pentaphyllus californicus Horn, 1870, p. 387.

DESCRIPTION.—Elongate oval, moderately convex, pale reddish brown, shining. Head with clypeus well defined, slightly prolonged beyond genae, anterior margin arcuate; genae rounded, slightly raised above antennal insertions; frons rather strongly convex in female, almost flat in male, unarmed in both sexes; eyes very small, widely separated both dorsally and ventrally; surface coarsely and densely punctured. Pronotum 1.5 times as broad as long, widest near middle, lateral margins uniformly feebly rounded, narrowly but distinctly expanded, very finely beaded; apical margin truncate, base nearly straight with lateral portions broadly expanded, thin and overlapping bases of elytra, slightly reflected in front of scutellum; both basal and apical angles obtuse and broadly rounded; entire surface coarsely, shallowly, and moderately densely punctured. Elytra with lateral margins parallel, abruptly attenuate and declivitous behind; surface coarsely, shallowly, and uniformly densely punctured. Scutellum relatively large, broadly triangular, sparsely punctulate. Ventral surface of pronotum deeply concave, smooth; prosternal process narrow between coxae, strongly carinate medially, horizontal, acutely pointed and prolonged apically; mesosternum flat, not forming V-shaped ridges in front of mesocoxae; remainder of ventral surface very coarsely and densely punctured, concolorous with dorsum; legs somewhat lighter, tibiae all slender, hindtarsus with basal segment slightly longer than two following combined and subequal to fourth; epipleura gradually narrowed, almost attaining apices of elytra. Aedeagus of male relatively broad and robust (pl. 3, fig. 18). Measurements: length 2.1–2.4mm.; width 0.9–1.2mm.

REMARKS.—Horn characterizes this species as "similar to *P. pallidus* in form, color, and sculpture, differing in being more depressed and with the centres of the first two abdominal segments brown, almost black."

It is indeed quite similar to *P. pallidus* and is relatively more depressed than that species. Horn's second character, on the other hand, is worthless taxonomically and may be ignored. The dark centers of the abdominal sternites to which he alludes occur with apparently equal frequency in both *P. pallidus* and the European *P. testaceus* as well as in *P. californicus*. It appears to be only a discoloration caused perhaps by food in the gut and may actually involve almost the entire abdomen.

The salient differences between *P. californicus* and *P. pallidus* have been discussed under the latter species. In one male specimen of *P. californicus* from Lake Tahoe, Calif. (USNM), there are very feeble, blunt indications of frontal tubercles. These could perhaps be construed as frontal tubercles by one who is unfamiliar with the development of these structures in males of *P. pallidus*. Otherwise this character is quite constant and useful.

The only ecological data available is that accompanying a male and female from Shasta County, Calif. (UCal) which were taken from under bark of mountain hemlock, *Tsuga mertensiana*.

Type.—ANSP 3991. Labeled "Cala", stated as Fort Crook by Horn in the original description.

Specimens examined.—From the following localities, 35:

United States: California (Bass Lake, Kings Creek Meadow, Lake Tahoe, Miami, Sugar Pine, Tallac, Truckee).

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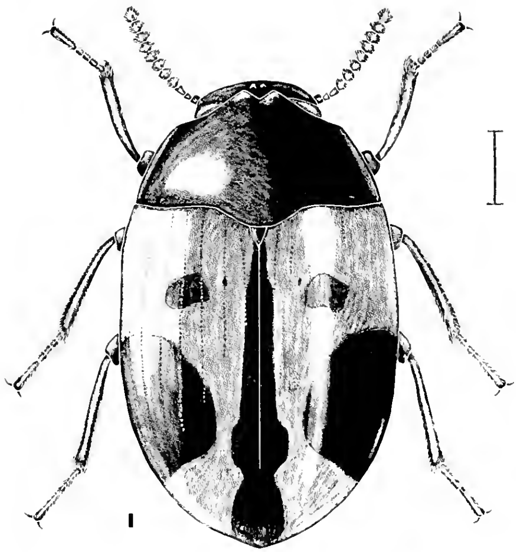
PLATES

PLATE 1

Fig. 1. *Diaperis maculata* Olivier, ♂ (line=1 mm.).
Fig. 2. *Diaperis maculata* Olivier, ♂, dorsal view of aedeagus (same scale as fig. 3).
Fig. 3. *Diaperis maculata* Olivier, ♂, lateral view of aedeagus (line=1 mm.).
Fig. 4. *Diaperis nigronotata* Pic, left elytron (same scale as fig. 1).
Fig. 5. *Diaperis rufipes* Horn, left elytron (same scale as fig. 1).
Fig. 6. *Diaperis rufipes* Horn, ♀, lateral view of ovipositor (line in fig. 3=0.5 mm.).
Fig. 7. *Diaperis rufipes* Horn, ♂, dorsal view of aedeagus (same scale as fig. 3).
Fig. 8. *Diaperis rufipes* Horn, ♂, lateral view of aedeagus (same scale as fig. 3).



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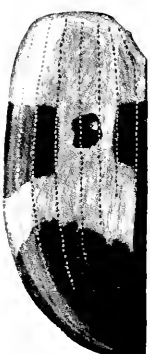

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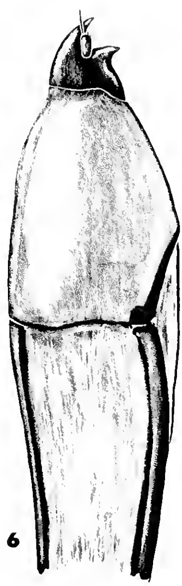

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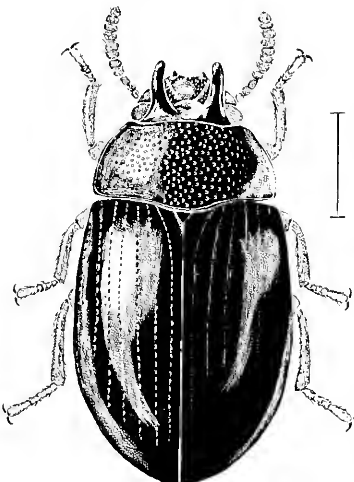
PLATE 2

Fig. 9. *Neomida bicornis* (Fabricius), ♂ (line = 1 mm.).
Fig. 10. *Palembus ocularis* Casey, ♂ (line = 1 mm.).
Fig. 11. *Platydema subcostatum* Laporte and Brullé (line = 1 mm.).
Fig. 12. *Scaphidema aeneolum* (LeConte) (line = 1 mm.).



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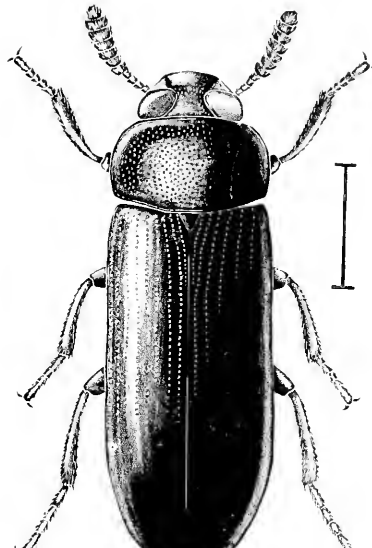

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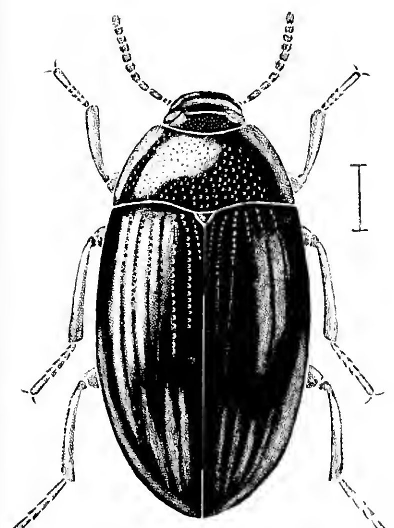

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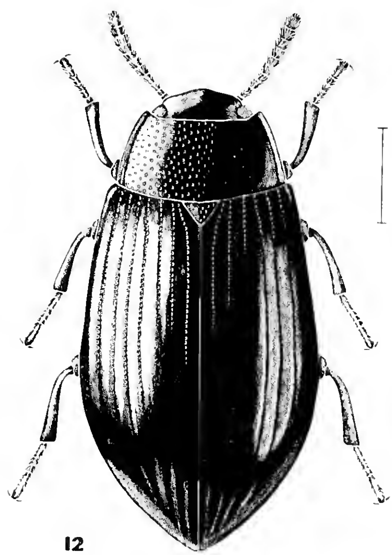

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PLATE 3

Fig. 13. *Liodema laeve* (Haldeman) (line = 1 mm.).

Fig. 14. *Liodema laeve* (Haldeman), ventral view of thorax, legs removed (same scale as fig. 13).

Fig. 15. *Liodema laeve* (Haldeman), ♂, ventral view of aedeagus (line = 0.5 mm.).

Fig. 16. *Pentaphyllus pallidus* LeConte (line = 1 mm.).

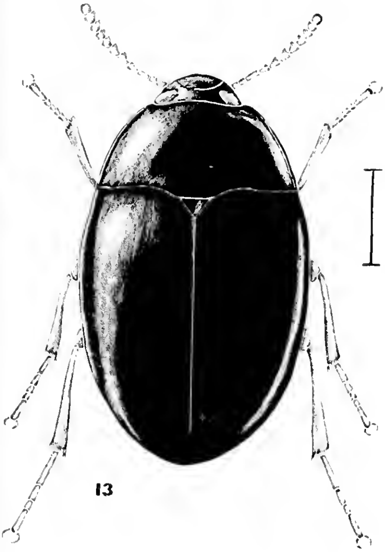
Fig. 17. *Pentaphyllus pallidus* LeConte, ♂, dorsal view of aedeagus (same scale as fig. 18).

Fig. 18. *Pentaphyllus californicus* Horn, ♂, dorsal view of aedeagus (line = 0.25 mm.).

Fig. 19. *Scaphidema metallicum* (Fabricius), ♂, dorsal view of aedeagus (same scale as fig. 15).

Fig. 20. *Scaphidema aeneolum* (LeConte), ♂, dorsal view of aedeagus (same scale as fig. 15).

Fig. 21. *Palembus ocularis* Casey, ♂, dorsal view of aedeagus (same scale as fig. 15).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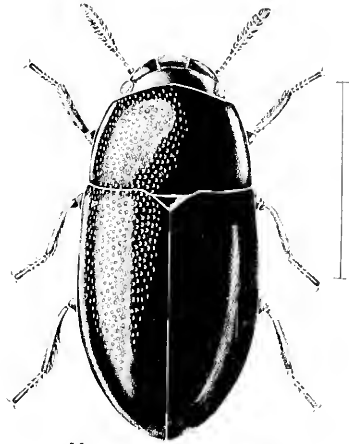
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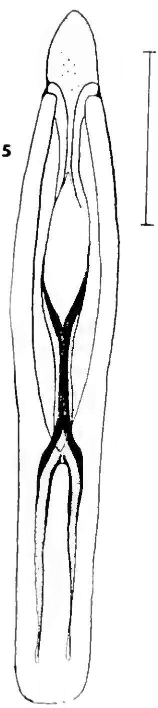
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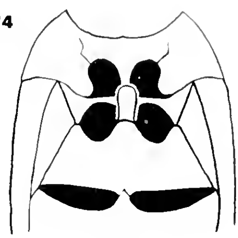
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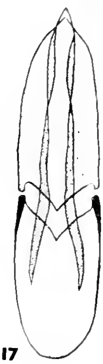
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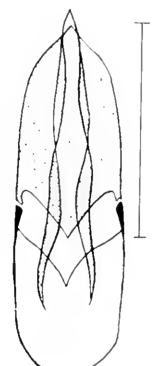
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PLATE 4

Fig. 22. *Platydema excavatum* (Say), ♂, dorsal view of aedeagus.
Fig. 23. *Platydema excavatum* (Say), ♂, dorsal view of aedeagus with penis extended.
Fig. 24. *Platydema cyanescens* Laporte and Brullé, ♂, dorsal view of aedeagus.
Fig. 25. *Platydema americanum* Laporte and Brullé, ♂, dorsal view of aedeagus.
Fig. 26. *Platydema mexicanum* Champion, ♂, dorsal view of aedeagus.
Fig. 27. *Platydema oregonense* LeConte, ♂, dorsal view of aedeagus.
Fig. 28. *Platydema neglectum* new species, ♂, dorsal view of aedeagus.
Fig. 29. *Platydema laevipes* Haldeman, ♂, dorsal view of aedeagus.
Fig. 30. *Platydema picilabrum* Melsheimer, ♂, dorsal view of aedeagus.
Fig. 31. *Platydema subcostatum* Laporte and Brullé, ♂, dorsal view of aedeagus.
(line=0.5 mm.)

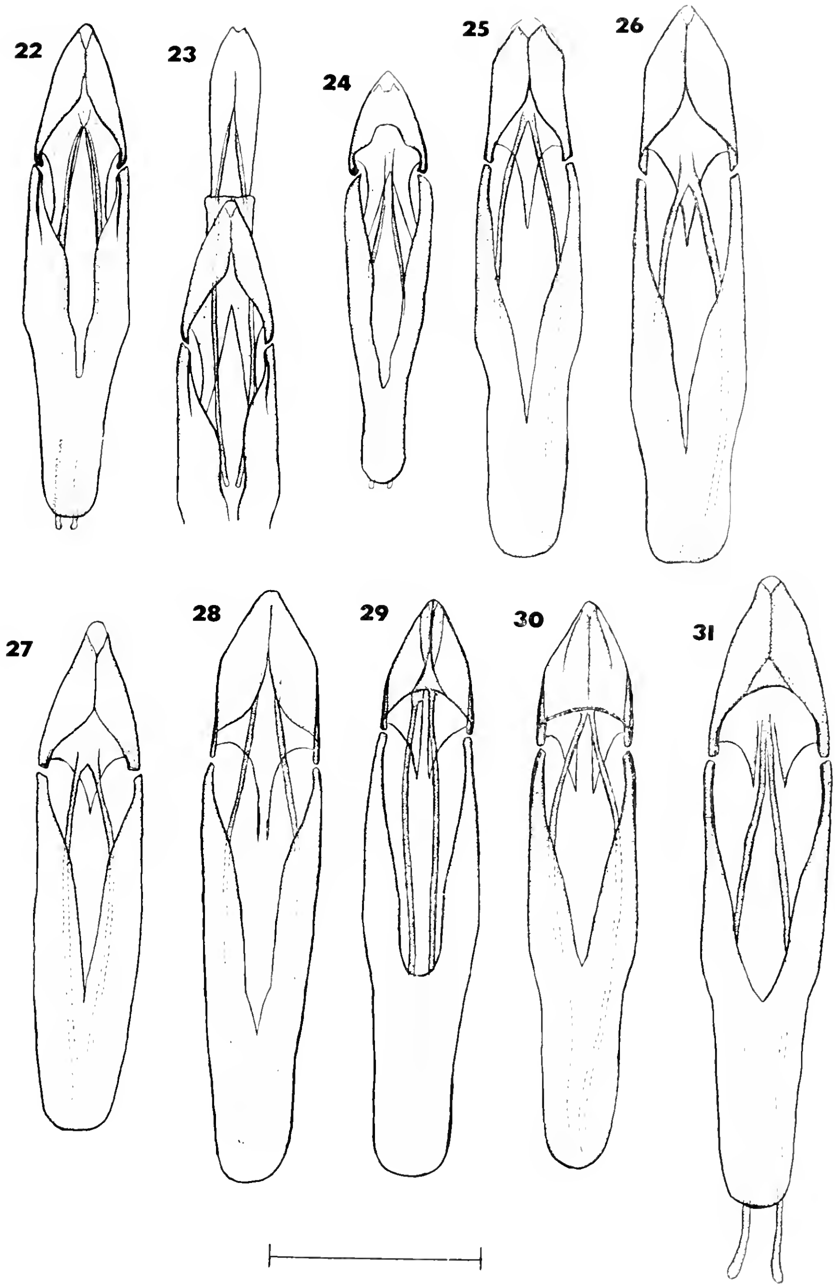
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PLATE 5

Fig. 32. *Platydema zandae* new species, ♂, ventral view of aedeagus.
Fig. 33. *Platydema micans* Zimmerman, ♂, dorsal view of aedeagus.
Fig. 34. *Platydema micans* Zimmerman, ♂, lateral view of aedeagus.
Fig. 35. *Platydema inquilinum* Linell, ♂, dorsal view of aedeagus.
Fig. 36. *Platydema inquilinum* Linell, ♂, lateral view of aedeagus.
Fig. 37. *Platydema ellipticum* (Fabricius), ♂, ventral view of aedeagus.
Fig. 38. *Platydema nigratum* (Motschoulsky), ♂, ventral view of aedeagus.
Fig. 39. *Platydema nigratum* (Motschoulsky), ♂, dorsal view of aedeagus.
Fig. 40. *Platydema ruficorne* (Sturm), ♂, ventral view of aedeagus.
Fig. 41. *Platydema ruficorne* (Sturm), ♂, lateral view of aedeagus.
Fig. 42. *Platydema americanum* Laporte and Brullé, ♀, dorsal view of ovipositor.
Fig. 43. *Platydema erythrocerum* Laporte and Brullé, ♂, ventral view of aedeagus.
Fig. 44. *Platydema erythrocerum* Laporte and Brullé, ♂, lateral view of aedeagus.
Fig. 45. *Platydema flavipes* (Fabricius), ♂, ventral view of aedeagus.
Fig. 46. *Platydema flavipes* (Fabricius), ♂, dorsal view of aedeagus.
Fig. 47. *Platydema ruficolle* Laporte and Brullé, ♂, ventral view of aedeagus.
Fig. 48. *Platydema ruficolle* Laporte and Brullé, ♂, lateral view of aedeagus.

(line=0.5 mm.)

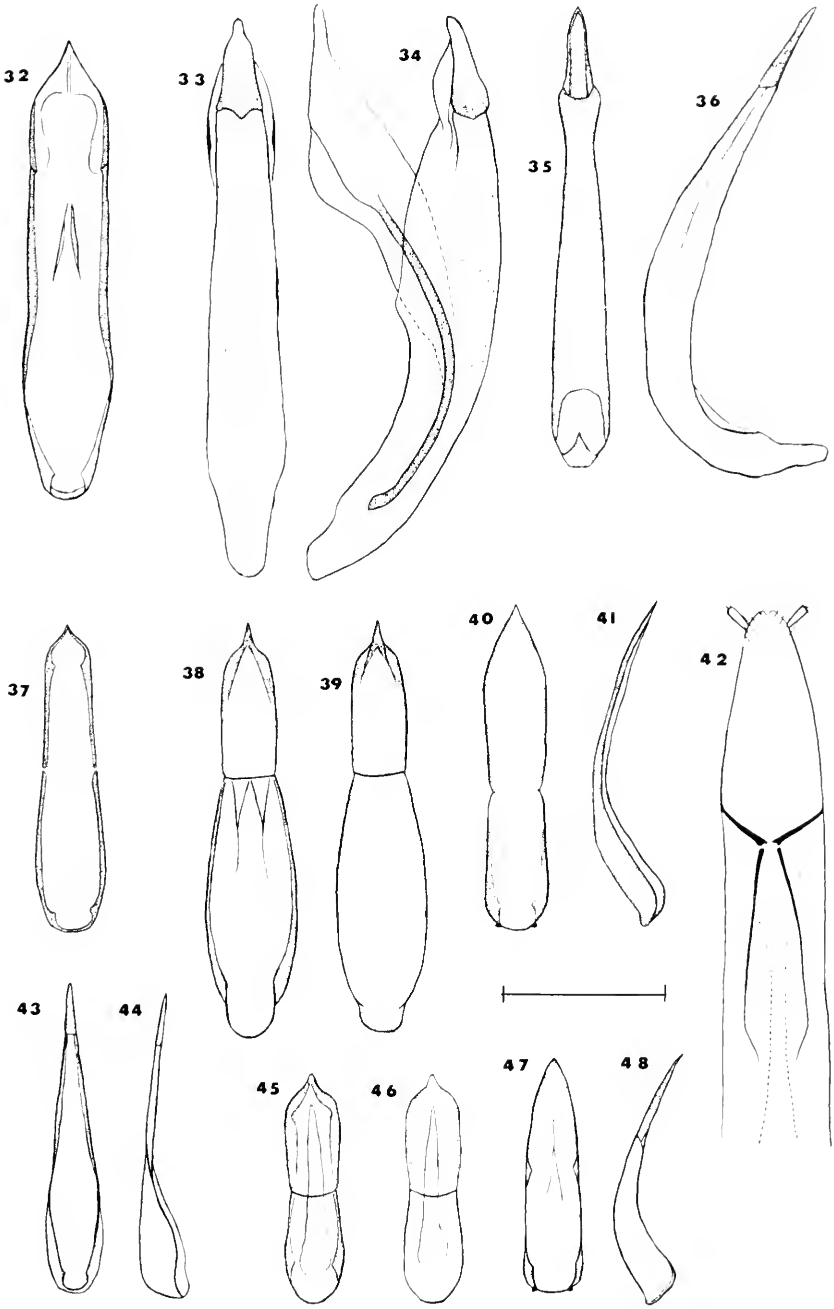
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PLATE 6

Fig. 49. *Apsida belti* Bates, ♀, dorsal view of ovipositor (line=0.5 mm.).
Fig. 50. *Apsida belti* Bates, ♂, lateral view of aedeagus (same scale as fig. 49).
Fig. 51. *Apsida belti* Bates, ♂, ventral view of aedeagus (same scale as fig. 49).
Fig. 52. *Platydema neglectum* new species, pronotum.
Fig. 53. *Platydema americanum* Laporte and Brullé, pronotum.
Fig. 54. *Platydema neglectum* new species, terminal two antennal segments.
Fig. 55. *Alphitophagus bifasciatus* (Say), ♂, dorsal view of aedeagus (same scale as fig. 49).
Fig. 56. *Alphitophagus bifasciatus* (Say), ♂, dorsal view of apex of aedeagus with penis extended (same scale as fig. 49).
Fig. 57. *Alphitophagus bifasciatus* (Say), ♂, dorsal view of head (line=0.5 mm.).
Fig. 58. *Neomida haemorrhoidalis* (Fabricius), ♂, dorsal view of aedeagus (same scale as fig. 59).
Fig. 59. *Neomida myllocnema* new species, ♂, dorsal view of aedeagus (line=1 mm.).
Fig. 60. *Neomida ferruginea* (LeConte), ♂, dorsal view of aedeagus (same scale as fig. 59).
Fig. 61. *Neomida bicornis* (Fabricius), ♂, dorsal view of aedeagus (same scale as fig. 59).
Fig. 62. *Neomida aeneipennis* new species, ♂, dorsal view of aedeagus (same scale as fig. 59).
Fig. 63. *Neomida bicornis* (Fabricius), ♂, clypeus.
Fig. 64. *Neomida aeneipennis* new species, ♂, clypeus.
Fig. 64a. *Uloporus ovalis* Casey, ♂, ventral view of aedeagus (line=0.5 mm.).
Fig. 64b. *Uloporus ovalis* Casey, ♂, right metathoracic leg (same scale as fig. 64a).

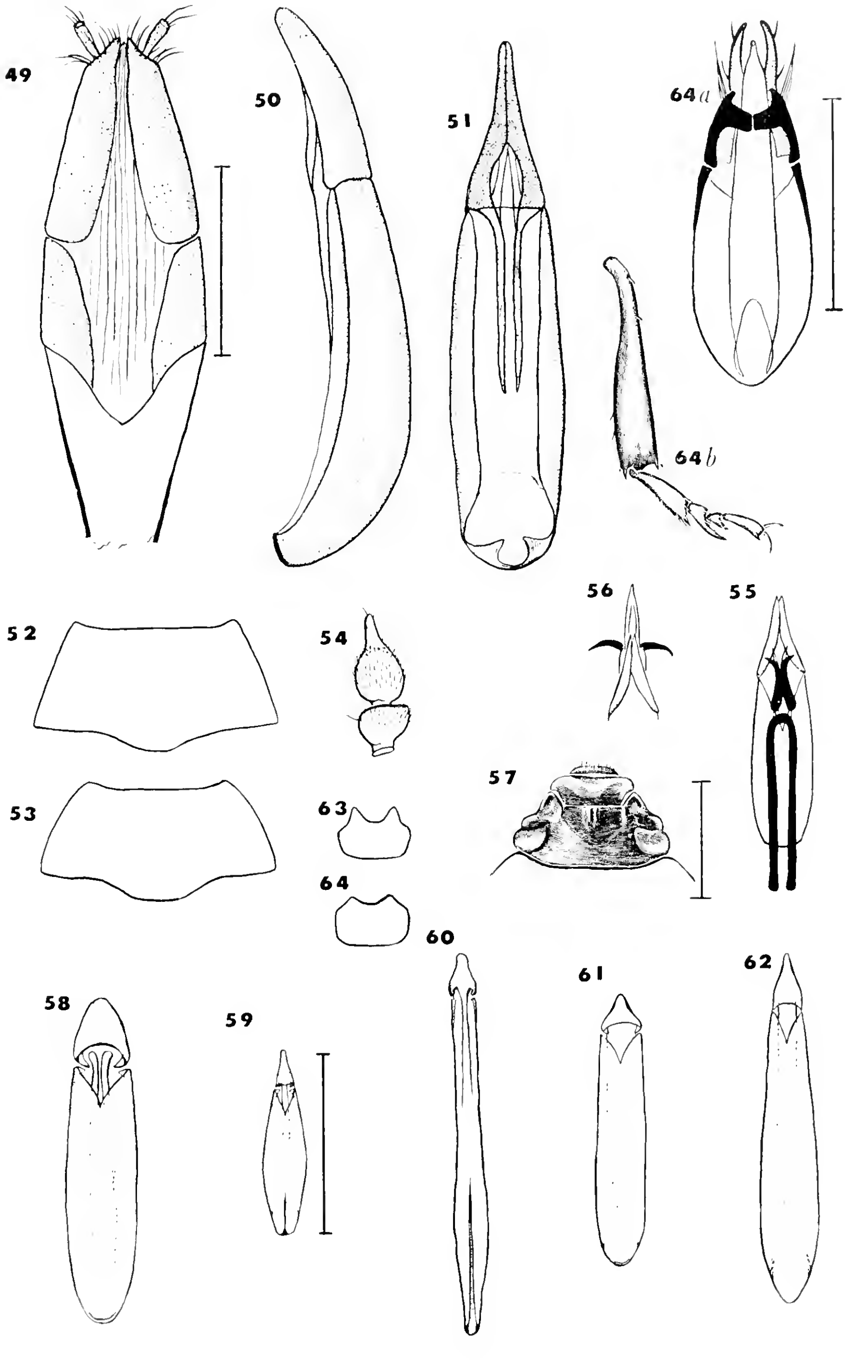
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PLATE 7

Fig. 65. *Apsida belti* Bates, ♂.

Fig. 66. *Platydema teleops* new species, showing eyes separated ventrally by more than three times the longer axis of one eye.

Fig. 67. *Platydema excavatum* (Say), ♂.

Fig. 68. *Platydema teleops* new species, holotype, ♂ (above) and allotype, ♀ (below).

Fig. 69. *Platydema mexicanum* Champion, Lectotype (BMNH).


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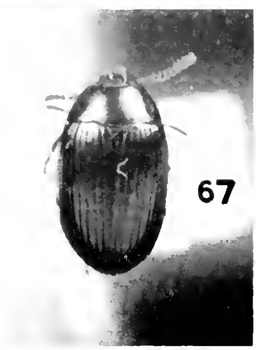
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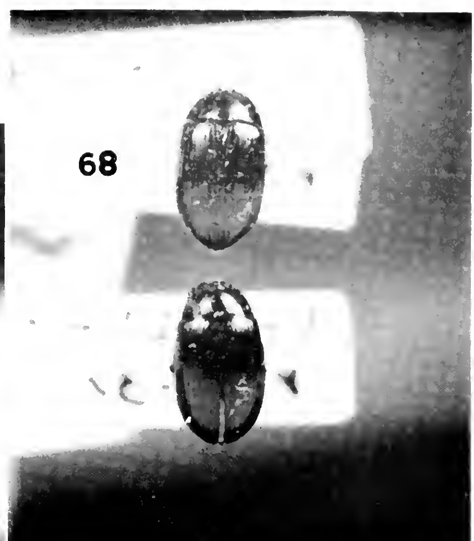
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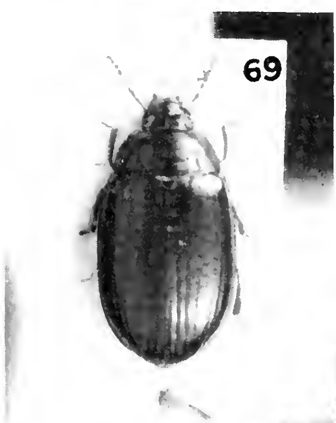
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MARINE AMPHIPODA OF ATOLLS IN MICRONESIA

By J. Laurens Barnard
Associate Curator, Division of Crustacea

Introduction

Two large collections of intertidal and sublittoral Amphipoda were made on several atolls of Micronesia, one containing material collected by Dr. D. P. Abbott of Stanford University and Dr. F. M. Bayer of the Smithsonian Institution on Ifaluk Atoll, and by Dr. Cadet Hand of the University of California on Kapingamarangi Atoll, and the other by Dr. D. J. Reish of Long Beach State College, California, on Eniwetok, Majuro, and Bikini atolls. The Abbott-Bayer-Hand collection was made available to me by Dr. Fenner A. Chace, Jr. of the U.S. National Museum, and a small grant was provided from the National Research Council for initial sorting of the specimens. The collections of Dr. Reish were made possible by help from the Atomic Energy Commission. All specimens have been deposited in the U.S. National Museum. I am most grateful to the Beaudette Foundation for my support during this investigation. Dr. Abbott very kindly reviewed the manuscript and made several valuable suggestions.

Previous studies.—Tropical Pacific amphipods have not been studied extensively but the fauna would be expected to contain species common to other parts of the tropics, such as the Indian Ocean and Red Sea. Therefore, few of the common species in the collections proved to be new, especially since Schellenberg (1938a) had already reported on collections from Fiji, Gilbert, Ellice, Marshall and

Hawaiian islands. Chevreux (1908) reported on amphipods of the Gambier archipelago. Dana (1853) described numerous tropical Pacific species, some of them still obscure because only the females were described; but his work provided the groundwork for later study.

Other important tropical studies were made in the Indian Ocean by Chevreux (1901, Seychelles) and Walker (1904, Ceylon; 1905, Laccadives and Maldives; 1909, general) and in the Red Sea by Schellenberg (1928) and Spandl (1924). The numerous works of Haswell, Chilton and Hurley in Australia and New Zealand show that little relationship of those faunas is borne to the tropics, but of course the northern half of Australia still has not been explored for amphipods. Pirlot's excellent series of Siboga monographs (1930–38), although primarily of interest for the deep sea, nevertheless contains valuable information on shallow-water Indonesian and Philippine amphipods.

Faunistic impoverishment of atolls.—Atolls and small volcanic islands of Micronesia are of especial interest to faunistic biologists because an impoverishment of many groups of organisms would be expected in comparison with faunas of large islands and continents in the tropics. Micronesia primarily offers an epifaunal environment in the shallow sea, with scarce remnants of muddy coastal shelves fringing larger islands and continents. Hence the lack of shallow sea bottoms, the diminution of environmental variability and the decrease of food from runoff should be limiting factors. Since most Amphipoda are either debris and detritus feeders or algal chewers they especially should be restricted in diversity. Although fine calcareous muds exist in lagoons of atolls and support burrowing amphipods, apparently not many dredgings or grab samples have been taken in the past, for there are few ampeliscids, phoxocephalids, haustoriids, and oedicerotids reported from atolls or sharply sloped islands and few are expected because atoll waters are so free of the detrital food of these organisms. Thus, the amphipod fauna of atolls should be composed largely of those species nestling in epifaunal coral reefs, those chewing the limited fleshy algae in these environments, and the inquilinous forms that are subparasites in coelenterates, ascidians, and sponges. In comparison with continents, atolls should present a repletion of these hosts, especially coelenterates.

Unfortunately, the amphipods of continents in the tropics are poorly known so that comparison with islands is impossible. A great deal of work remains to be done in Indonesia, the south China Sea and all the continental coasts of the tropical Indian Ocean before any idea of faunal diversity is realized. Many other comparisons of vital interest are impossible because of the lack of knowledge in the area so outlined. For instance, it is not known whether increased diversification of amphipods occurs from the cold-temperate to the tropics because of

increased temperature or whether this diversification is associated with the richer epifaunal habitats of the tropics. No comparisons of the tropical Indo-Pacific with the eastern Pacific and Atlantic Oceans can be made.

TROPICAL INDO-PACIFIC AMPHIPOD FAUNA.—A summary of the gammaridean Amphipoda of the tropical Indo-Pacific is presented in table 1. It is restricted to species found between the Tropics of Cancer and Capricorn from the east shores of Africa to the Marquesas Islands and includes the Red Sea. It contains species found intertidally and subtidally down to depths of 200 feet. Not included are the terrestrial species of the Talitridae nor oceanic pelagic species.

Of shallow water marine faunas it has been presumed that the Indo-Pacific represents the longest known belt of relatively uniform environment in terms of narrow temperature range and so it is expected that a large proportion of species ranges throughout the Indo-Pacific. Barriers to dispersal of animals are most notable in the eastern part of the Indo-Pacific where long stretches of open sea separate archipelagoes.

Amphipoda are crustaceans brooding their eggs and hatching their young as miniature adults so that dispersal is not accomplished by pelagic larvae. That so many species of Amphipoda, not only in the tropics but in colder regions, have been disposed over widespread areas attests to their dispersive success, regardless of the lack of larvae. A number of species appears to be transported successfully on floating algae. Through the courtesy of Dr. Torben Wolff, the writer examined samples of floating seaweed collected by the *Galathea* Expedition in the Indo-Pacific region, in the Mozambique Channel, Seychelles, Celebes, and Philippine Sea. Amphipods often were collected from these materials in great abundance, especially *Ampithoe ramondi*, *Cymadusa filosa*, *Elasmopus pectenicrus* (note that *E. ecuadorensis* appears to be a variety of this), and *Stenothoe gallensis*. All of these species are widely spread in the intertidal of the Indo-Pacific and probably they form a normal faunal component on floating seaweeds, perhaps in greater density than that found on attached plants. Expeditions should be advised to collect more surface flotsam to discover other amphipods being dispersed in this manner.

Amphipods dwelling on intertidal algae probably are more widely distributed in the Indo-Pacific because of accidental dispersal by means of flotsam than are those species living on the sublittoral benthos and building tubes or nestling among fixed bits of hard substrate. Nevertheless, many sublittoral amphipods span deep barriers.

Although many groups of animals have been studied extensively in the tropics, little effort has been expended on the Amphipoda. One problem is that amphipods are quite small in the tropics (J. L.

Barnard 1962d); they are difficult to study because techniques of amphipod study have not benefitted from those of copepodologists or ostracodologists. Often the animals are so small that they are overlooked or are lost in coarse-meshed screens; hence, the best known tropical amphipods are those that are largest, such as species of *Elasmopus*, *Paragrubia*, *Ampithoe*, *Maera*, and *Hyale*. Many tropical amphipods autotomize their appendages when preserved, making analysis more difficult. In addition, a high proportion of tropical Amphipoda belongs to genera where gnathopodal characters form the basis of identification and these characters appear only at or after sexual maturity and/or only in males; hence, female and juvenile specimens often cannot be identified without co-occurrence of males, and many samples are therefore worthless. Once life history studies can be conducted it will be possible to identify these nonmales, but the practicing faunistic taxonomist is often unable to solve such problems, especially when collections are so meager. Still another difficulty seems to be the large number of aberrations found in populations of tropical amphipods, especially in such dominant genera as *Hyale*, *Elasmopus*, *Maera*, and *Eurystheus*. These four genera are highly diverse, the known species in them numbering, respectively, 45, 35, 32, and 55 (worldwide). Aberrancies also occur rather more frequently in the species of these genera in colder waters than in other genera as observed by the writer. Because of their high diversity one would expect that the species of these genera would show more variation than species in smaller genera. Such morphological variants probably represent both mutants and ecophenotypes, and they pose problems often insoluble to the morphological taxonomist.

Potential atoll fauna.—Since atolls have little shelf area, therefore few silts and silty sands in the open sea surrounding them, the atoll fauna is largely epifaunal, composed mainly of species nestling in algae or building tubes on hard objects or inquilinous species commensal with larger organisms. In table 1, I have placed an asterisk on those species in these categories which I believe would occur in Micronesian atolls. I have eliminated from consideration those species known to burrow in soft bottoms, such as species of *Ampelisca*, *Paraphoxus*, *Urothoe* and all others for which ecological knowledge is poor.

The ubiquity of the tropical fauna is poorly demonstrated as shown by the occurrence of epifaunal species of amphipods (see table 1): Red Sea only, 11; Red Sea to Indonesia, 45; Indonesia to Hawaii, 63; Red Sea to Hawaii, 31; total, 150. Of those 150 potential atoll species, only 30 are known from the "Red Sea to Hawaii" (table 1, cols. 1–3, 5–7) or what I call pandemic in the Indo-Pacific. Since the Red Sea may have a number of endemic elements, I have cate-

gorized these separately. More species are now known from Indonesia to Hawaii than from the Red Sea to Indonesia, indicating that exploratory efforts in the past few decades have been concentrated in the Pacific rather than in the Indian Ocean as they were in earlier decades. No doubt a large share of those species now restricted to one side of Indonesia will turn up on the other side. Considerable exploration is warranted.

Including the present research, 65 species of amphipods are now known from Micronesia, of which 23 are technically endemic, 13 of these being described as new in this paper. All but 7 of the 65 species are considered to be algal or epifaunal dwellers. Thus, of 139 expected Indo-Pacific species (less those of the Red Sea), 58 have been collected in Micronesia. A better way to express the situation is to remove the endemic species from both figures so that, of 116 previously described species, only 35 have so far been collected in Micronesia.

Apparently, with the work of Schellenberg (1938a) and the present effort, the Micronesian amphipod fauna is better known than that of any other Indo-Pacific area, since more of the expected 150 epifaunal, possibly ubiquitous species (those with asterisks in table 1), have been collected in Micronesia. The number of epifaunal amphipod species reported from each Indo-Pacific region, with an expected total of 150, shows the following distribution: Red Sea, 41; E. Africa, 36; India, 52; Indonesia, 34; Micronesia, 58; Polynesia, 33; Hawaii, 23.

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*= Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
Amaryllis macrophthalma (incl. *A. tenuipes*)	X	X	X				
Ampelisca australis						X	
Ampelisca brachyceras			X				
(*Ampelisca brevicornis*)	X	X	X				
Ampelisca cyclops		X	X	X			
Ampelisca cf. *daleyi* (not *Byblis daleyi* Pirlot 1936)			X				
Ampelisca lunata						X	
(*Ampelisca pusilla*)			X				
Ampelisca pygmaea						X	

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
Ampelisca scabripes		X	X				
Ampelisca subbrevicornis				X			
(*Ampelisca tenuicornis*)		X					
Ampelisca tridens			X	X			
Ampelisca zamboangae	X		X	X			
Ampelisciphotis tridens				X			
**Amphilochus brunneus*			X				
**Amphilochus marionis*					X		X
**Amphilochus neapolitanus*		X					
Amphithoides longicornis	X						
Amphithoides patrizii		X					
**Ampithoe falsa*		X					
**Ampithoe orientalis*				X			X
**Ampithoe ramondi*	X	X	X	X	X	X	X
(*Ampithoe tongensis*)						X	
**Anamixis falarikia*, new species					X		
**Anamixis stebbingi*			X		X		
Andaniexis spinescens			X				
(*Anonyx amaurus*)			X				
(*Anonyx indicus*)			X				
(*Anonyx schmardae*)			X				
(*Aora typica*)			X			X	
Argissa hamatipes			X				
Aristias tropicus						X	
Arugella heterodonta				X			
Atylopsis latipalpus		X					
**Atylus guttatus*	X						
**Atylus granulosus*			X				
**Atylus minikoi*			X				
**Audulla chelifera*		X	X				
**Azotostoma fusta*, new species					X		
**Beaudettia palmeri*, new species					X		
Byblis crenulata				X			
Byblis daleyi of Pirlot 1936				X			
Byblis kallarthra				X			
Byblis lepta		X	X				
Byblis mucronata				X			
Byblis rhinoceros				X		X	
**Calliopius pictus*				X			
Ceina egregia				X			
**Ceradocus hawaiensis*							X
**Ceradocus rubromaculatus*	X	X	X	X	X	X	

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
Cerapus tubularis (see J. L. Barnard 1962a)		X	X	X			
**Cheiriphotis megacheles*		X	X	X			
**Cheiriphotis monuropus*	X	X	X				
Chelura terebrans	X						
Chelura insulae				X	X	X	X
**Chevalia aviculae*	X	X	X				
**Colomastix hamifera*	X						
**Colomastix pusilla*	X		X		X		X
Concholestes dentalii			X				
Corophium acherusicum	X			X			X
Corophium acutum	X						
Corophium bonelli	X						
Corophium triaconyx			X				
Corophium orientalis	X						
**Cymadusa brevidactyla*					X	X	
**Cymadusa filosa*	X	X	X	X	X		X
**Cymadusa hawaiensis*							X
**Cymadusa oceanica*							X
**Cyproidea ornata*	X		X			X	
**Cyproidea serratipalma*					X		
Cyrtophium orientale				X			
(*Dexamine miersi*)				X			
**Dexamine serraticrus*			X				
**Dexamine spinosa*	X						
**Dexamine thea*	X						
Dexaminella aegyptiaca	X						
**Dexaminoides orientalis*	X				X		
**Elasmopus atolgidus*, new species					X		
**Elasmopus buchneri*	X						
**Elasmopus ?brasiliensis*					X		
**Elasmopus calliactis*							X
**Elasmopus caprai*	X	X					
**Elasmopus dentiferus*					X	X	
**Elasmopus diplonyx*					X		
**Elasmopus dubius*			X				
**Elasmopus ecuadorensis hawaiensis*							X
**Elasmopus erythraeus*	X	X					
**Elasmopus excavatus*					X		
**Elasmopus gracilis*						X	
**Elasmopus minimus*				X		X	

Table 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
**Elasmopus pectenicrus*	X	X	X	X		X	X
**Elasmopus pocillimanus*					X		
**Elasmopus pseudaffinis*					X		
**Elasmopus rapax*	X	X	X		X	X	X
**Elasmopus spinidactylus*			X		X	X	
**Elasmopus spinimanus*			X	X	X		
**Elasmopus steinitzi*	X						
**Elasmopus suensis*				X			
Eriopisa chilkensis			X				
Eriopisella sechellensis	X		X				
Ericthonius brasiliensis	X	X	X				X
Ericthonius macrodactylus			X	X			
(*Ericthonius peculans*)				X			
Ericthonius pugnax				X			
**Eurystheus afer*	X	X					
**Eurystheus atlanticus*	X	X	X	X	X		
**Eurystheus digitatus*					X	X	
**Eurystheus iminens*	X						
**Eurystheus lophomeria*		X					
**Eurystheus pacificus*					X	X	
**Eurystheus setiferus*					X		
Eusiroides diplonyx			X	X	X		X
Eusiroides monoculoides			X?			X	
Eusiroides orchomenipes			X				
Glycerina tenuicornis			X	X			
Grandidierella bispinosa						X	
Grandidierella bonnieri			X				
Grandidierella gilesi			X	X			
Grandidierella gravipes			X				
Grandidierella macronyx			X				
Grandidierella mahafalensis		X					
Grandidierella megnae			X				
Grandidierella perlata						X	
Guernea coalita			X?				
Guernea petalocera	X						
Haustoriopsis reticulatus						X	
Hornellia incerta			X				
**Hyale affinis*						X	X
**Hyale bishopae*							X
**Hyale chevreuxi*			X		X		
**Hyale dentifera*					X	X	

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
**Hyale galateae*				X			X
(*Hyale gracilis*)						X	
**Hyale honoluluensis*					X		X
**Hyale media* (incl. *H. ayeli*)			X		X		X
**Hyale nigra*	X	X					
(*Hyale orientalis*)				X			
**Hyale pusilla*						X	
Icilius ovalis				X			
Ichnopus taurus	X		X	X			
Idunella chilkensis			X				
Iphimedia discreta	X				X	X	
Iphimedia gladiolus		X					
Iphimedia orchestimana	X						
**Ischyrocerus* cfr. *inexpectatus*	X						
(*Ischyrocerus anguipes*)			X?				
Jassa falcata	X	X	X	X			
(*Jassa orientalis*)				X			
Kuria longimanus		X					
**Laetmatophilus leptocheir*		X					
**Lembos aequimanus*					X	X	X
**Lembos bryopsis*, new species					X		
**Lembos chelatus*			X				
(*Lembos fuegiensis*)						X	
**Lembos hastatus*					X		
**Lembos intermedius*							X
**Lembos kergueleni*		X	X				
**Lembos leptocheirus*	X	X					
**Lembos macromanus*				X			
**Lembos podoceroides*	X	X	X			X	
**Lembos processifer*				X	X		
(*Lembos tenuis*)				X			
**Lembos* species (cf. *francanni*)					X		
Leptocheirus pilosus		X					
**Leucothoe acanthopus*	X						
**Leucothoe brevidigitata*				X			
(*Leucothoe crassimana*)	X						
**Leucothoe furina*	X	X	X	X		X	
**Leucothoe hyhelia*, new species					X		
**Leucothoe minuscula*					X		
**Leucothoe micronesiae*, new species					X		

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
?*Leucothoe spinicarpa*	X	X	X	X			
(=*Leucothoella bannwarthi*?)							
**Leucothoe stegoceras*	X		X				
**Leucothoe ?tridens*				X	X		
**Leucothoella bannwarthi*	X			X	X	X	
**Leucothoides pottsi*	X				X		
**Liagoceradocus pusillus*, new species					X		
Liljeborgia aequabilis				X			
Liljeborgia dubia				X			
(*Liljeborgia pallida*)			X				
Liljeborgia proxima					X	X	
Listriella dahli						X	
Lysianassa coelochir		X	X				
Lysianassa ceratina	X	X					
Lysianassa cinghalensis	X	X	X				
(*Maera aspera*)				X			
**Maera furcicornis*				X			
**Maera hamigera*	X				X		
**Maera inaequipes*	X	X	X		X		
**Maera inaequipes serrata*					X		
(*Maera indica*)				X			
**Maera insignis*			X	X	X	X	X
**Maera latibrachium*			X	X			
**Maera mastersi*				X		X	
(*Maera massavensis*)	X						
**Maera othonides*			X	X			
**Maera othonopsis*					X		
**Maera pacifica*					X	X	X
(*Maera pubescens*)					X		
**Maera quadrimana*					X	X	X
**Maera schellenbergi*	X						
**Maera sokotrae*		X					
**Maera subcarinata*		X	X	X			
*(*Maera tenella*)		X	X	X		X	
**Maera viridis*						X	
**Maerella tenuimana*				X			
Mandibulophoxus uncirostratus			X				
Megaluropus agilis	X		X				
**Megamphopus abbotti*, new species					X		
**Melita appendiculata* (=*fresneli*)	X	X	X	X			X

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
**Melita inaequistylis* (incl. *M. tenuicornis* of Walker 1909)			X				
**Melita obtusata*			X?				
**Microdeutopus tridens*					X		
Microlysias indica		X					
Microphotis blachei				X			
(*Microprotopus emissitius*)				X			
Ochlesis innocens				X	X		
Orchomenella nana			X				
Paracalliope fluviatilis			X				
Paracalliope indica			X				
Paradexamine flindersi				X			
**Paragrubia vorax*			X		X	X	X
Parambasia forbesi		X					
**Paranamixis bocki*					X	X	
Paraphoxus centralis							X
Paraphoxus rostratus				X			
Paraphoxus species of Pirlot				X			
**Parelasmopus albidus*					X	X	
**Parelasmopus resacus*, new species					X		
**Parelasmopus suluensis*	X	X	X	X		X	
**Parhyale hawaiensis*	X	X	X	X	X	X	X
Parhyalella indica			X				
Parhyalella pietschmanni							X
Perioculodes aequimanus	X						
Perioculodes cfr. *longimanus*	X		X				
Perioculodes (*megapleon*)			X				
Perioculodes serra			X				
Pereionotus testudo		X					
**Photis digitata*			X				
**Photis distinguenda*		X					
**Photis dolichommata*		X		X?			
**Photis geniculata*			X				
**Photis hawaiensis*							X
**Photis lamellifera*	X						
**Photis longicaudata*	X	X	X				
**Photis longimanus*			X				
**Photis nana*			X				
Platyischnopus herdmani			X				
(*Pleonexes dubius*)		X					
**Podocerus africanus*		X					

Table 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
**Podocerus andamanensis*			X				
Podocerus brasiliensis	X	X	X				X
**Podocerus inconspicuus*		X		X			
**Podocerus laevis*			X				
**Podocerus ?lobatus*				X			
**Podocerus mangarevae*						X	
**Podocerus talegus*, new species					X		
**Podocerus zeylanicus*			X				
**Polycheria antarctica*			X	X			
**Polycheria atolli*	X	X	X				
**Pontogeneia pacifica*							X
Quadrivisio bengalensis		X	X			X	
**Ronco sosa*, new species					X		
Siphonoecetes erythraeus	X						
Siphonoecetes orientalis		X	X				
Socarnella bonnieri			X				
Sphaerophthalmus grobbeni	X						
**Stenothoe antennulariae*		X					
**Stenothoe gallensis*	X	X	X			X	X
(*Stenothoe guernii*)		X					
**Stenothoe monoculoides*			X				
Stenothoe valida	X						X
Sunamphitoe orientalis of K. H. Barnard 1937		X					
Sunamphitoe pelagica				X?			
**Synchelidium brevicarpum*			X				
**Synchelidium haplocheles*			X				
Synopia scheeleana			X				
Synopia ultramarina	X			X			
Synopia variabilis	X				X		
Syrrhoe semiserrata						X	
Tiron thompsoni			X				
Tmetonyx mucronatus				X			
Tryphosa cucullata			X				
Unciolella lunata	X						
Urothoe elegans	X						
(*Urothoe irrostrata*)				X			
Urothoe pestai	X						
Urothoe spinidigitus			X				
Urothoe ruber			X				
Waldeckia kroyeri				X			

TABLE 1.—*List of Indo-Pacific tropical gammaridean Amphipoda from the literature* (*=Known epifaunal intertidal species; all others are subtidal, benthic, or of unknown ecology; species in parentheses are dubious. See J. L. Barnard, 1958, for references)—Continued

	Red Sea	East Africa	Arabian Sea, India, Bay of Bengal	Indonesia (North Australia)	Micronesia	Polynesia	Hawaiian Islands
**Xenocheira fasciata*				X			
**Xenocheira seurati*						X	

COMPOSITION OF THE COLLECTIONS.—The collections are divided into two major groups, those of Dr. Abbott from Ifaluk Atoll, with 794 specimens and those of Dr. Reish from Eniwetok, Bikini, and Majuro Atolls, with 851 specimens. Although the collections are similar in size, their relative compositions differ remarkably. Reish's collections were screened through a mesh of 0.5 mm.; hence a number of small species found in the Abbott collections apparently were lost. Of the 48 identified species in the two collections, only 17 were found in both, 23 were found only in the Ifaluk material and 8 were found only in the Eniwetok material. Many of the 23 from Ifaluk are small species, such as *Colomastix*, leucothoids, anamixids, and small gammarids. The 10 most abundant species from both collections are shown in table 2. Only 5 of these, according to their ubiquity indices (3 or above), are truly Indo-Pacific cosmopolitan forms. The remaining 5, so far have been reported only from the Pacific east of Indonesia and 3 of these have been discovered only in Micronesia. None of the top 10 is a new species and so most of the 5 Pacific forms may be endemic and not penetrate westward into the Indian Ocean.

Eleven of the 38 minor species, of lesser abundance than the top 10, are new. Of the remaining 26 species, probably 9 are truly pan-Indo-Pacific and pan-tropical as follows: *Leucothoella bannwarthi*, *Leucothoides pottsi*, *Colomastix pusilla*, *Elasmopus brasiliensis*, *Maera inaequipes*, *Hyale media*, *Dexaminoides orientalis*, *Eurystheus atlanticus*, and *Paragrubia vorax*. None of these was exceptionally abundant in the Micronesian collections.

Four of the new species appear to be inquilines associated with sessile animals of the substrate and probably feeding semiparasitically upon them. They are in the genera *Azotostoma*, *Anamixis*, and *Leucothoe*. The remaining new species are described in the genera *Ronco*, *Lembos*, *Elasmopus*, *Beaudettia*, *Pleonexes*, *Liagoceradocus*, *Megamphopus*, and *Podocerus*.

TABLE 2.—*Amphipods most abundant in the atoll samples collected* (Ubiquity index indicates number of areas through which species are distributed, from table 1; the higher the number, the more widespread the species)

Species	Total specimens	Ifaluk	Eniwetok Majuro Bikini	Ubiquity index
Elasmopus pseudaffinis	203	61	142	1
Cymadusa filosa [1]	185	60	125	6
Maera insignis	178	171	7	5
Elasmopus spinidactylus	174	35	139	3
Ampithoe ramondi [1]	126	1	125	7
Microdeutopus tridens	107	106	1	1
Hyale honoluluensis	74	0	74	2
Parhyale hawaiensis [1]	59	55	4	7
Eurystheus digitatus	59	40	19	2
Maera inaequipes serrata	55	44	11	1

[1] Cosmopolitan.

DOMINANT EPIFAUNAL GENERA.—Disregarding both those genera in table 1 known to occupy sandy and silt bottoms (such as *Ampelisca*, *Paraphoxus*, etc.) and brackish water genera (*Grandidierella* and *Corophium*) and considering only those species collected from washes of epifaunal materials such as algae, rocks, coral heads, it is seen that 8 large genera dominate tropical faunas (table 3). These dominant genera are best represented in the tropics as evidenced by a count of their species in the Arctic-subarctic, using two publications, Gurjanova (1951) and Shoemaker (1955). Casual inspection of Antarctic and subantarctic papers demonstrates the same relationships. Nevertheless, several of the genera, such as *Hyale*, *Photis*, and *Eurystheus*, are better represented in the subtropics, warm-temperate and cold-temperate than they are in the tropics. Probably this situation prevails because subtropical to cold-temperate zoogeographic provinces are more isolated from each other by temperature and continentally controlled barriers than are either tropics or Arctic-subarctic, and thus more endemism has developed. For example, the warm-temperate eastern Pacific is isolated from warm-temperate Japan by a deep water barrier of great magnitude and from warm-temperate Europe by a continent and an ocean. On the other hand the warm-tropic waters form a continuous band from Africa through Indonesia to Panama but warm-temperate waters are barred from continuity by continents. Cold Arctic and subarctic waters are relatively continuous.

TABLE 3.—*Dominant amphipod genera in the Tropics, with number of species in Tropics, Arctic-subarctic, and remaining world areas*

Genera	Tropical	Arctic-subarctic	Remainder
Elasmopus	21	2	10
Eurystheus	8	2	44
Hyale	9	4	30
Lembos	10	3	14
Leucothoe (inquilinous)	8	2	10
Maera	14	5	15
Photis	9	5	20
Podocerus	8	0	11

COLLECTING LOCALITIES.—Eniwetok and Ifaluk Atolls have gone under various names. Equivalent names for Eniwetok appear on chart 6 by Emery, Tracey and Ladd (1954), in a list by Dawson (1957), and on an insert map issued by the Eniwetok Marine Biological Laboratory (EMBL). Those for Ifaluk appear in Tracey, Abbott and Arnow (1961), which contains the only adequate charts of that atoll. Equivalent names are listed below. The names chosen by Dawson (1957) and by Tracey, Abbott and Arnow (1961) are used in the present paper.

ENIWETOK ATOLL

Dawson (1957)	Emery et al. (1954)	EMBL Map
Bogombogo	Bogombogo	Belle
Engebi	Engebi	Janet
Aaraanbiru	Arambiru	Vera
Aniyaanii	Japtan	Bruce
Japtan	Muti	David
Bogen	Bogen	Rex
Parry	Parry	Elmer
Eniwetok	Eniwetok	Fred
Igurin	Igurin	Glenn
Rigili	Rigili	Leroy

IFALUK ATOLL

Tracey et al. (1961)	Board of Geographic Names
Ifaluk Atoll	Ifalik Atoll [sic]
Falarik Island	Ifalik Island
Falalap Island	Flalap Island [sic]
Ella Island	Ella Island
Elangalap Island	Moai Island

Station List

Ifaluk Atoll

Collected by Dr. D. P. Abbott, 1953

13–C–1, wash of corallines and corals, upper 30 ft. of zone of spurs and grooves outside algal ridge, reef east of the south end of Falarik Islet, Aug. 25.
Elasmopus spinidactylus, 8; *Eurystheus digitatus*, 1

14–B–3, wash of *Porolithon*, same data as 13–C–1.
Elasmopus spinidactylus, 14; *Eurytheus digitatus*, 11

15–C–2, wash of coral *Pocillopora* and alga *Halimeda*, same data as 13–C–1.
Eurystheus ?digitatus, 2

18–E–4, wash of corallines and other algae, same data as 13–C–1.
Elasmopus spinidactylus, 1

19–E–3, wash of corallines and other algae, same data as 13–C–1.
Cymadusa filosa, 1; *Eurystheus aigitatus*, 3

22–D–5, algal ridge on reef east of south end of Falarik Islet, intertidal, Sept. 4.
Maera insignis, 6

23–E–2, wash of algae and rock fragments, same data as 22–D–5.
Cymadusa filosa, 1; *Elasmopus atolgidus*, new species, 1; *Maera insignis*, 1

24–C–1, wash of rocks bearing corallines and other algae, same data as 22–D–5.
Elasmopus spinidactylus, 9; *Maera insignis*, 4

26–F–2, wash from algae, same data as 22–D–5.
Maera insignis, 6

27–F–1, wash of corallines and other algae, same data as 22–D–5.
Maera insignis, 4

28–D–3, wash from algae, same data as 22–D–5.
Elasmopus ?pseudaffinis, 2; *Eurystheus digitatus*, 5; *Maera insignis*, 2

29–C–1, wash from algae, same data as 22–D–5.
Elasmopus spinidactylus, 3; *Maera insignis*, 3

30–C–4, wash from algae, same data as 22–D–5.
Elasmopus pseudaffinis, 2; *Maera insignis*, 5

31–D–2, wash from algae, same data as 22–D–5.
Eurystheus digitatus, 1; *Lembos intermedius*, 1; *Maera insignis*, 10; *Maera othonopsis*, 1; *Microdeutopus tridens*, 2; *Roneo sosa*, new genus, new species, 1

32–G–3, wash from algae, same data as 22–D–5.
Eurystheus digitatus, 2; *Lembos* species (near *francanni*), 1; *Maera insignis*, 7; *Microdeutopus tridens*, 1

39–E–5, wash from algae, floor of outermost quarter of outer reef flat, reef east of the south end of Falarik Islet, covered by a few inches of water even at the lowest tides, Sept. 17.
Elasmopus pseudaffinis, 3; *Eurystheus digitatus*, 3; *Maera insignis*, 2; *Podocerus talegus*, new species, 1

40–E–3, wash from algae, same data as 39–E–5.
Maera inaequipes serrata, 1; *Maera insignis*, 16; *Microdeutopus tridens*, 1

41–D–3, wash from algae, same data as 39–E–5.
Azotostoma fusta, new genus, new species, 2; *Eurystheus digitatus*, 1; *Leucothoides pottsi*, 1; *Maera insignis*, 21; *Microdeutopus tridens*, 2; *Podocerus talegus*, new species, 3

42–F–2, wash from algae, same data as 39–E–5.
Azotostoma fusta, new genus, new species, 2; *Cymadusa ?filosa*, 2; *Elasmopus rapax*, 2; *Eurystheus ?digitatus*, 2; *Maera inaequipes serrata*, 2; *Maera insignis*, 15; *Microdeutopus tridens*, 1

44–D–3, wash from algae, same data as 39–E–5.
Maera insignis, 3

46–E–2, wash from algae, from floor of innermost third of outer reef flat, reef east of the south end of Falarik Islet, exposed by lowest tides, Sept. 17.
Azotostoma fusta, new genus, new species, 1; *Eurystheus ?digitatus* 2; *Maera insignis*, 7

48–E–1, wash from algae, same data as 46–E–2.
Maera insignis, 13

49–E–2, wash from algae and sponges, same data as 46–E–2.
Eurystheus ?digitatus, 2; *Maera insignis*, 10; *Maera pacifica*, 4

50–E–1, wash from algae, same data as 46–E–2.
Leucothoe tridens, 1; *Maera insignis*, 17

51–C–2, from rocks bearing algae, boulder flat forming the inner reef flat, reef west of Elangalap Islet, intertidal, Sept. 20.
Parhyale hawaiensis, 4

53–B–3, wash from rock bearing alga, *Cladophoropsis*, same data as 51–C–2.
Parhyale hawaiensis, 3

55–C–3, wash from algae on dead coral rocks, from boulder flat, lagoon shelf adjacent to shore, east side of Elangalap Islet, intertidal and upper subtidal, Sept. 20.
Parhyale hawaiensis, 5

57–E–2, wash from algae and corals, *Heliopora* heads of lagoonward reef margin, reef between Ella and Elangalap Islets, depth 2–6 feet, Sept. 20.
Elasmopus pseudaffinis, 1

58–F–2, wash from algae, same data as 57–E–2.
Azotostoma fusta, new genus, new species, 1; *Elasmopus pseudaffinis*, 3

60–D–1, wash from algae, same data as 57–E–2.
Elasmopus pseudaffinis, 1

66–E–10, wash from algae and corals, algal ridge, 20 yards in from breaker line, western reef between Elangalap Islet and north end of Falarik Islet, intertidal, Sept. 21.
Azotostoma fusta, new genus, new species, 1; *Elasmopus pseudaffinis*, 3; *Eurystheus digitatus*, 3; *Maera insignis*, 3

69–E–7, wash from algae and *Tubipora*, same data as 66–E–10.
Maera insignis, 1

70–C–3, wash from algae and *Tubipora*, same data as 66–E–10.
Elasmopus pseudaffinis, 1

72–G–3, wash from algae and corals, inner reef flat, about halfway between breakers and lagoonward reef margin, western reef between Elangalap Islet and the north end of Falarik Islet, depth, about 6 inches at low tide, Sept. 21.
Elasmopus pseudaffinis, 2; *Eurystheus ?pacificus*, 2; *Maera inaequipes*, 3

76–H–3, wash from algae, inner reef flat about two thirds of the way inward from breaker line toward lagoonward reef margin, western reef between Elangalap Islet and north end of Falarik Islet, depth, about 6 inches at low tide, Sept. 21.
Cymadusa filosa, 1; *Elasmopus pseudaffinis*, 1; *Lembos intermedius*, 3; *Maera inaequipes serrata*, 1

81–B–4d, wash from alga *Microdictyon*, patch reef on lagoon shelf west of the southwest end of Falarik Islet, 3 fathoms, Sept. 28.

Maera inaequipes serrata, 2; *Microdeutopus tridens*, 4; *Parelasmopus resacus*, new species, 17

83–E–1, wash from algae, old elevated reef remnant at junction of outer and inner reef flats, reef east of the south end of Falarik Islet, intertidal, Sept. 29.
Cymadusa filosa, 1; *Elasmopus pseudaffinis*, 3; *Eurystheus ?digitatus*, 2; *Maera insignis*, 3; *Maera ?pacifica*, 7; *Parhyale hawaiensis*, 1

84–D–1, wash from algae, inner reef flat, about 130 feet from shore, reef east of the south end of Falarik Islet, intertidal, Sept. 29.
Cymadusa filosa, 8; *Elasmopus pseudaffinis*, 2; *Maera ?pacifica*, 2

85–F–3, wash from algae, about 100 feet from shore, same data as 84–D–1.
Elasmopus pseudaffinis, 2; *Maera ?pacifica*, 1

87–H–2, wash from algae, 70 feet from shore, same data as 84–D–1.
Elasmopus brasiliensis, 7

89–F–3, wash from algae, about 35 feet from shore, same data as 84–D–1.
Elasmopus brasiliensis, 11

90–C–4, wash from algae, about 35 feet from shore, same data as 84–D–1.
Cymadusa filosa, 2; *Elasmopus excavatus*, 1

91–E–2, wash from algae, almost at shoreline, same data as 84–D–1.
Cymadusa filosa, 4; *Maera insignis*, 1; *Maera ?pacifica*, 10; *Parhyale hawaiensis*, 11

95–D–4, wash from algae, inner reef flat 375–450 feet in from breaker line, reef north of northwest end of Falarik Islet, intertidal, Oct. 2.
Elasmopus pseudaffinis, 2

95–L–4, wash from algae, 450–550 feet in from breaker line, same data as 95–D–4.
Cymadusa filosa, 2; *Elasmopus brasiliensis* 2; *Elasmopus pseudaffinis*, 1

95–O–4, wash from algae, 600 feet in from breaker line, same data as 95–D–4.
Elasmopus brasiliensis, 3; *Maera pacifica*, 1

99–F–3, wash from algae *Halimeda*, lagoon bottom a very large sandy knoll covered with *Halimeda*, depth 36 feet, Oct. 3.
Leucothoella bannwarthi, 2

102–B–2, wash from algae and corallines on dead coral branches, depth 33 feet on patch reef on bottom near center of lagoon, Oct. 3.
Azotostoma fusta, new genus, new species, 1; *Parelasmopus resacus*, new species, 6

112–I–5, from turtle grass beds, lagoon shelf near shore, lagoon west of Katelu area of sourthwest Falarik Islet, depth 0–2 feet, Oct. 7–8.
Cymadusa filosa, 1; *Maera pacifica*, 1; *Microdeutopus tridens*, 1

113–H–2, same data as 112–I–5, Oct. 8–9.
Colomastix pusilla, 2; *Cymadusa filosa*, 1; *Leucothoella bannwarthi*, 2; *Maera inaequipes serrata*, 27; *Microdeutopus tridens*, 10

116–F–3, same data as 112–I–5, Oct. 8–9.
Colomastix pusilla, 1; *Cymadusa filosa*, 1; *Lembos* species (near *francanni*), 5; *Leucothoella bannwarthi*, 1; *Maera inaequipes serrata*, 2

122–C–1, wash from algae on *Tubipora* colony, bottom of ship pass between Ella and Falalap Islets, depth 2.5 fathoms, Oct. 18.
Azotostoma fusta, new genus, new species, 1; *Colomastix pusilla*, 1; *Leucothoe micronesiae*, 2

123–D–2, wash from alga *Liagora*, zone of spurs and grooves outside west tip of Falielang, near ship pass, depth 1 fathom, Oct. 18.
Cymadusa filosa, 7; *Liagoceradocus pusillus*, new genus, new species, 2

124–D–3, wash from *Halimeda* rooted in sand, lagoon shelf on west side of lagoon between Elangalap Islet and the northwest end of Falarik Islet, depth 9 feet, Oct. 19.
Dexaminoides orientalis, 1; *Lembos intermedius*, 2

125–D–3, wash from algae growing on dead *Heliopora*, lagoonward reef margin western reef between Elangalap Islet and northwest end of Falarik Islet, depth 1–6 feet, Oct. 19.
Dexaminoides orientalis, 3; *Elasmopus pseudaffinis*, 1; *Maera inaequipes serrata*, 2

126–C–4, wash from algae, same data as 125–D–3.
Maera inaequipes serrata, 1; *Microdeutopus tridens*, 3

128–C–5, wash from algae, same data as 125–D–3.
Elasmopus pseudaffinis, 2; *Lembos* species (near *francanni*), 1; *Lembos intermedius*, 1; *Maera insignis*, 1.

130–C–2, wash from algae, same data as 125–D–3.
Elasmopus pseudaffinis, 4

132–E–4, from dead coral head, lying on edge of lagoon shelf, sandy bottom, between Elangalap Islet and north end of Falarik Islet, depth 12 feet, Oct. 19.
Elasmopus pseudaffinis, 1; *Microdeutopus tridens*, 1

136–C–4, wash from *Halimeda*, lagoonward reef margin, western reef between Elangalap Islet and north tip of Falarik Islet, depth 1 fathom, Oct. 20.
Microdeutopus tridens, 1

137–E–6, wash from *Halimeda*, same data as 136–C–4.
Microdeutopus tridens, 9

138–E–4, wash from algae, same data as 136–C–4.
Microdeutopus tridens, 4.

139–C–2, wash from corallines and other algae, west reef between Elangalap Islet and north tip of Falarik Islet, depth 6 inches to 3 feet, Oct. 20.
Cymadusa filosa, 1; *Elasmopus pseudaffinis*, 7.

141–D–3, wash from algae, lagoonward reef margin, depth 1 fathom, same data as 139–C–2.
Elasmopus pseudaffinis, 1; *Maera inaequipes serrata*, 1; *Maera quadrimana*, 1; *Microdeutopus tridens*, 2; *Parelasmopus albidus*, 1; *Pleonexes* species, 1

142–E–4, wash from algae, same data as 141–D–3.
Elasmopus pseudaffinis, 6; *Maera inaequipes serrata*, 1

144–F–2, wash from algae, patch reef on lagoon shelf, 75 feet from shore, off Katelu area of southwest Falarik Islet, depth 1–3 feet, Oct. 21.
Cymadusa filosa, 2; *Maera inaequipes serrata*, 1

145–C–2, wash from algae growing on dead coral, same data as 144–F–2.
Anamixis falarikia, new species, 1; *Anamixis stebbingi*, 1

145–C–3, wash from algae on dead coral, same data as 144–F–2.
Cymadusa filosa, 5; *Parelasmopus resaeus*, new species, 2

146–151–H–4, wash from coral fragments covered with algae, 50–100 feet from shore, depth 0–4 feet, same data as 144–F–2, Oct. 22.
Elasmopus pseudaffinis, 2; *Microdeutopus tridens*, 1

152–D–3, depth 2–6 feet, same data as 146–151–H–4.
Parelasmopus resaeus, 2

155–157–G–1, wash from algae, southwestern reef between Elangalap and Ella Islets, depth 1 fathom, Oct. 23.
Elasmopus pseudaffinis, 5; *Eurystheus pacificus*, 1; *Leucothoe micronesiae*, new species, 3; *Microdeutopus tridens*, 2

158–159–D–5, wash from algae growing in sand, lagoon shelf north of center of Ella Islet, depth 2 fathoms, Oct. 24.
Elasmopus pseudaffinis, 1; *Leucothoides pottsi*, 1; *Microdeutopus tridens*, 7

160–165–J–5, wash from algae and rocks, about 700 feet west of west shore of Elangalap Islet, depth 25–35 feet, Oct. 25.
Megamphopus abbotti, new species, 1; *Eurystheus pacificus*, 1; *Lembos ?intermedius*, 1; *Leucothoe tridens*, 1; *Leucothoides pottsi*, 1; *Maera inaequipes*, 1; *Ronco sosa*, new genus, new species, 1

166–G–3, from shell of *Tridacna squamosa*, same data as 160–165–J–5.
Megamphopus abbotti, new species, 6

167–D–4, wash from *Halimeda*, from bottom of ship pass between Falalap and Ella Islets, depth 13–14 feet, Oct. 25.
Microdeutopus tridens, 3

176–G–4, from turtle grass and *Halimeda* beds, lagoon shelf off southwest tip of Falarik Islet, barely exposed at low tide, Oct. 27.
Lembos intermedius, 3; *Microdeutopus tridens*, 4

177–G–5, same data as 176–G–4.
Anamixis stebbingi, 1; *Cymadusa filosa*, 7; *Lembos intermedius*, 2; *Leucothoe micronesiae*, new species, 1; *Leucothoides pottsi*, 2; *Microdeutopus tridens*, 8

179–184–M–1, wash from algae, lagoon shelf beyond turtle grass beds, west of north end of Falalap Islet, depth 3–6 feet, Oct. 27.
Cymadusa filosa, 11; *Lembos intermedius*, 3; *Leucothoe micronesiae*, new species, 2; *Maera inaequipes serrata*, 3; *Microdeutopus tridens*, 35

192–D–6, wash from algae and dead coral, patch reef off Katelu area of southwest Falarik Islet, about 30 feet from lagoon shore, depth 1–3 feet, Oct. 29.
Cymadusa filosa, 1; *Microdeutopus tridens*, 2

194–E–2, plankton haul, surface of open lagoon, 2100–2300 hours, Oct. 10.
Synopia variabilis, 2

197–198–F–1, wash from rocks bearing *Cladophoropsis*, reef east of the east end of channel separating Falarik and Falalap Islets, intertidal, Oct. 31.
Eurystheus pacificus, 1; *Parhyale hawaiensis*, 25

208–C–7, wash from algae, from spurs and grooves, southwest reef between Ella and Elangalap Islets, depth 4–20 feet, Sept. 30.
Podocerus talegus, new species, 7

209–F–4, wash from algae dredged from large sandy knoll covered with *Halimeda*, depth 36 feet, Oct. 3.
Colomastix pusilla, 1

Collected by Dr. F. M. Bayer, Fourth Pacific Atoll Survey Team, Pacific Science Board, 1953

431, north end of Falarik, crustaceans from clump of *Pocillopora* on seaward reef edge, Oct. 1.
Maera insignis, 9; *Maera ?pacifica*, 1; *Podocerus talegus*, new species, 1

465, sponge and associated invertebrates from lagoon station C, 47.5 feet, Oct. 3.
Anamixis falarikia, new species, 1; *Leucothoides pottsi*, 1

467, sponge and associates, same data as 465.
Colomastix pusilla, 9; *Leucothoe micronesiae*, new species, 8; *Leucothoides pottsi*, 1

588, sand samples for foraminifers, seaward reef about middle of second 20 foot interval from reef margin, Falarik, Oct. 16.
Cymadusa filosa, 1

589, same data as 588, third 20 foot interval from reef margin.
Macra ?insignis, 1; *Podocerus talegus*, new species, 1

592, same data as 588, seventeenth 20-foot interval from reef margin.
Microdeutopus tridens, 1

594, sponges from coral rock, lagoon near the pass, Oct. 7.
Colomastix pusilla, 4; *Leucothoides pottsi*, 3

620, probably mislabeled sample of *Talorchestia spinipalma* from strand, labeled as from submerged coral knoll.

628, *Haminoea* and egg masses from *Thalassia* beds north of Katelu Benjo, lagoon shore at south end of Falarik, Oct. 9.
Cymadusa brevidactyla, 2

638, animals from crevices in *Porolithon* beds, seaward reef margin, middle of Falarik, Oct. 17.
Ronco sosa, new genus, new species, 1

670, orange sponge, lagoon off middle of Ella in 2–2.5 fathoms, Oct. 20.
Colomastix pusilla, 1

709, black sponge common on reefs, and white sponge which permeates interstices of coral heads, heliopore zone south of Elangalap, Oct. 23.
Colomastix pusilla, 3

754, sponge from flats on lagoon side north of Falalap, Oct. 27.
Microdeutopus tridens, 1

756, hydroids from clump of *Seriatopora* in ships pass 5–5.5 fathoms, Oct. 28.
Colomastix pusilla, 5; *Elasmopus pseudaffinis*, 1.

800, organisms from beneath boulders of elang on seaward reef at south end of Falarik, Oct. 31.
Parhyale hawaiensis, 1

821, erroneous label for *Talorchestia spinipalma*, sandhoppers.

Kapingamarangi Atoll

Collected by Dr. Cadet Hand, 1954

CH–551, rill zone, edge of algal mat, from coral, Hare, Aug. 4.
Ampithoe ?ramondi, 1

CH–609, ocean beach, Hare, Aug. 6.
Parhyale hawaiensis, 6

CH–682, coral head, Sokoro, Aug. 9.
Elasmopus pseudaffinis, 1

Eniwetok, Bikini, and Majuro Atolls

Collected by Dr. D. J. Reish, August, September 1956

E–2, Parry Island, ocean side, in front of EMBL, outer reef flat, algal holdfasts and clumps of sand, Aug. 20.
Cymadusa filosa, 1; *Elasmopus pseudaffinis*, 1

E–6, Rigili Island, ocean side, formalin washings from brown staghorn coral, Aug. 21.
Ampithoe ramondi, 3; *Cymadusa filosa*, 2; *Paragrubia vorax*, 3

E–13, Rigili Island, lagoon side, pieces of corals broken and washed in formalin, Aug. 21.
Ampithoe ramondi, 1

E–15, Parry Island, ocean side, in front of AEC quarters, inner reef flat, algal clumps with sand, Aug. 22.
Cymadusa filosa, 1

E–18, Parry Island, ocean side, in front of EMBL, surge zone, in clumps of alga, *Cladophora* species, Aug. 22.
Elasmopus pseudaffinis, 8

E–20, Parry Island, lagoon side, near EMBL, brown alga, *Chnoospora implex* Hering *ex* J. Agardh, attached to rocks just below water level, Aug. 23.
Ampithoe cf. *ramondi*, 2; *Eurystheus digitatus*, 1; *Paragrubia vorax*, 8

E–21, Aniyaanii Island, lagoon side, middle of island, cemented coral sand rock, Aug. 24.
Hyale honoluluensis, 1

E–24, Aniyaanii Island, lagoon side, middle of island, formalin washings of coral head, Aug. 24.
Ampithoe ramondi, 6; *Elasmopus rapax*, 3; *Eurystheus digitatus*, 4; *Microdeutopus tridens*, 1

E–25, Aniyaanii Island, ocean side, middle of island, reef flat alga, *Turbinaria ornata* (Turner), Aug. 24.
Cymadusa filosa, 5

E–26, Aniyaanii Island, ocean side, middle of island, corallina alga, *Porolithon ?oncodes*, from near surge zone, Aug. 24.
Ampithoe ramondi, 6; *Elasmopus pseudaffinis*, 2; *Elasmopus spinidactylus*, 5

E–27, Aniyaanii Island, ocean side, middle of island, reef flat, coral rock, Aug. 24.
Elasmopus pseudaffinis, 1

E–28, Aniyaanii Island, ocean side, middle of island, scrapings from undersurface of rock, Aug. 24.
Eurystheus digitatus, 1; *Maera inaequipes serrata*, 1

E–32, Aniyaanii Island, lagoon side at small boat dock, fouling organisms attached to pilings, Aug. 25.
Elasmopus pectenicrus, 10

E–38, Igurin Island, lagoon side, algae attached to rocks, Aug. 27.
Cymadusa filosa, 41; *Eurystheus digitatus*, 1; *Elasmopus pseudaffinis*, 1; *Hyale honoluluensis*, 5; *Paragrubia vorax*, 1

E–40, Igurin Island, lagoon side, alga, *Bryopsis* species, attached to rocks, Aug. 27.
Cymadusa filosa, 5; *Elasmopus pseudaffinis*, 1; *Eurystheus digitatus*, 1; *Lembos aequimanus*, 1; *Lembos bryopsis*, new species, 1; *Maera hamigera*, 7; *Maera inaequipes serrata*, 6

E–41, Igurin Island, lagoon side, preserved rocks, Aug. 27.
Cymadusa filosa, 1; *Eurystheus digitatus*, 1; *Eurystheus pacificus*, 2; *Maera hamigera*, 1

E–42, Igurin Island, lagoon side, sand washings from under rocks, Aug. 27.
Cymadusa filosa, 2; *Maera hamigera*, 5; *Maera inaequipes serrata*, 1

E–43, Igurin Island, ocean side, surge zone, coralline alga, *Halimeda macrophysa* Askenasy, Aug. 27.
Elasmopus pseudaffinis, 1; *Maera hamigera*, 3; *Maera othonopsis*, 1; *Paragrubia vorax*, 2

E–44, Igurin Island, ocean side, coralline alga, *Porolithon ?oncodes*, Aug. 27.
Ampithoe ramondi, 1; *Elasmopus pseudaffinis*, 2; *Maera inaequipes*, 7

E–45, Igurin Island, ocean side, rocky coral material taken from under coral head near surge zone, Aug. 27.
Megamphopus abbotti, new species, 1; *Eurystheus atlanticus*, 1

E–48, Japtan Island, ocean side, *Ectocarpus breviarticulatus* J. Agardh, alga growing in tide pools in reef flat area, Aug. 28.
Cymadusa filosa, 2

E–49, Japtan Island, ocean side, undersurface of old coral head in reef flat, Aug. 28.
Lembos aequimanus, 1

E–50, Japtan Island, lagoon side, algae growing to swimming float, Aug. 28.
Cymadusa filosa, 2; *Hyale honoluluensis*, 4

E–52, Parry Island, lagoon side at barge dock near EMBL, night light, over water 15 feet deep, sandy bottom, surface swimmers, Aug. 28.
Synopia variabilis, 12

E–53, Rigili Island, ocean side, old coral heads, coral rocks, Aug. 29.
Maera pacifica, 9

E–55, Rigili Island, lagoon side, alga *Boodlea composita* (Harv) Brand, Aug. 29.
Cymadusa filosa, 4; *Paragrubia vorax*, 2

ME–56, Majuro Atoll, Ulika Island, ocean side near hotel, under surface of rocks, small tidepool on reef flat, Aug. 30.
Elasmopus pseudaffinis, 1

ME–57, Majuro Atoll, Ulika Island, ocean side near hotel, algae mixed with sand attached to rocks on inner portion of reef flat, Aug. 30.
Cymadusa filosa, 1; *Elasmopus pseudaffinis*, 2

ME–60, Majuro Atoll, Ulika Island, ocean side near hotel, coarse sand with a little algae from inner reef flat, Aug. 30.
Cymadusa filosa, 7

ME–62, Majuro Atoll, Ulika Island, ocean side near hotel, rocks from inner reef flat area, Aug. 30.
Parhyale hawaiensis, 4

E–68, Parry Island, ocean side near EMBL, algae growing on reef flat area near surge zone, Sept. 2.
Elasmopus pseudaffinis, 1; *Eurystheus digitatus*, 1; *Hyale honoluluensis*, 16

E–72, Aaraanbiru Island, ocean side, coralline algae (rocks) from surge zone (*Porolithon ?oncodes*), Sept. 4.
Ampithoe ramondi, 6; *Hyale dentifera*, 5

E–73, Aaraanbiru Island, ocean side, algae, *Porolithon* species, Sept. 4.
Elasmopus spinidactylus, 13; *Hyale dentifera*, 2; *Hyale media*, 4

E–74, Aaraanbiru Island, ocean side, *Turbinaria ornata*, alga growing near surge zone, Sept. 4.
cf. *Ampithoe ramondi*, 3; *Hyale chevreuxi*, 11

E–75, Aaraanbiru Island, ocean side, rocks at surge zone, Sept. 4.
Cymadusa filosa, 4; *Elasmopus ?pseudaffinis*, 6; *Maera ?insignis*, 1; *Maera quadrimana*, 1

E–76, Aaraanbiru Island, ocean side, *Halimeda gigas* Taylor, alga from surge zone, Sept. 4.
Elasmopus spinidactylus, 1; *Paragrubia vorax*, 1

E–77, Aaraanbiru Island, ocean side, *Porolithon* species, coralline alga rock from surge zone, Sept. 4.
Elasmopus spinidactylus, 10; *Hyale media*, 4; *Maera quadrimana*, 5

E–78, Aaraanbiru Island, ocean side, coral head from surge zone, Sept. 4.
Elasmopus pseudaffinis, 5

E–81, Aaraanbiru Island, lagoon side, algae attached to rocks, Sept. 4.
Cymadusa filosa, 6

E–82, Aaraanbiru Island, lagoon side, coral rock and cemented coarse coral sand rock with algae attached, Sept. 4.
Ampithoe ramondi, 8; *Cymadusa filosa*, 2

E–83, Aaraanbiru Island, ocean side, algae and red sponge attached to reef flat, Sept. 4.
cf. *Maera insignis*, 1; *Paragrubia vorax*, 14

E–85, Aaraanbiru Island, ocean side, algae attached to reef flat, Sept. 4.
Maera inaequipes serrata, 1; *Maera quadrimana*, 9; *Paragrubia vorax*, 1

E–86, Aaraanbiru Island, ocean side, reef flat, coral rock with algae attached, Sept. 4.
Elasmopus pseudaffinis, 1

E–88, Aaraanbiru Island, ocean side, algae attached to reef flat, Sept. 4.
Maera quadrimana, 17

E–93, Eniwetok Island, ocean side, *Caulerpa racemosa* var. *peltata* (Lamx.) Eubank forma, algae from surge zone, Sept. 5.
Elasmopus pseudaffinis, 15; *Elasmopus spinidactylus*, 8; *Eurystheus digitatus*, 4; *Hyale honoluluensis*, 10; *Paragrubia vorax*, 3

E–94, Eniwetok Island, ocean side, *Chnoospora implexa*, alga from surge zone, Sept. 5.
cf. *Ampithoe ramondi*, 2; *Elasmopus spinidactylus*, 11; *Hyale media*, 8

E–95, Eniwetok Island, ocean side, *Porolithon* species, coralline algae rocks from surge zone, Sept. 5.
Cymadusa filosa, 2; *Elasmopus spinidactylus*, 6

E–96, Eniwetok Island, ocean side, *Porolithon* species, old coralline algae rocks, some algae, Sept. 5.
Elasmopus pseudaffinis, 1; *Elasmopus spinidactylus*, 1; *Eurystheus digitatus*, 1

BE–100, Bikini Atoll, Enyu Island, ocean side, *Porolithon ?oncodes*, coralline algal rocks, Sept. 6.
Elasmopus pseudaffinis, 3

BE–101, Bikini Atoll, Enyu Islands, ocean side, *Porolithon* species, coralline algal rock from surge zone, Sept. 6.
Elasmopus spinidactylus, 35; *Hyale dentifera*, 1; *Hyale honoluluensis*, 10; *Hyale media*, 22

BE–102, Bikini Atoll, Enyu Island, ocean side, *Caulerpa racemosa*, algae from pot holes in surge zone, Sept. 6.
Elasmopus pseudaffinis, 5; *Hyale chevreuxi*, 8

BE–103, Bikini Atoll, Enyu Island, ocean side, *Codium* species algae from surge zone, Sept. 6.
Ampithoe ramondi, 2; *Elasmopus pseudaffinis*, 6

BE–104, Bikini Atoll, Enyu Island, ocean side, reef flat near surge zone, Sept. 6.
Ampithoe ramondi, 1; *Elasmopus pseudaffinis*, 4; *Lembos aequimanus*, 1

BE–107, Bikini Atoll, Enyu Island, *Halimeda opuntia*, algae from tide pool in middle of reef flat area, Sept. 6.
Elasmopus pseudaffinis, 4; *Paragrubia vorax*, 2

BE–108, Bikini, Enyu Island, ocean side, old *Porolithon* species and coarse coral sand and cemented rock from reef flat, Sept. 6.
Elasmopus spinidactylus, 2

BE–109, Bikini, Enyu Island, ocean side, many species of algae attached to rocks on reef flat, forming a mat, Sept. 6.
Cymadusa filosa, 7; *Elasmopus ?pseudaffinis*, 1

BE–111, Bikini, Enyu Island, lagoon side, *Halimeda opuntia*, algae attached to large rock, Sept. 6.
Elasmopus pseudaffinis, 38

BE–112, Bikini, Enyu Island, lagoon side, cemented coral sand rock, Sept. 6.
Elasmopus spinidactylus, 20

BE–113, Bikini, Enyu Island, lagoon side, rocks of cemented coral sand, Sept. 6.
Elasmopus spinidactylus, 21

BE–114, Bikini, Enyu Island, ocean side, inner reef flat, sand under small rocks, some algae, Sept. 6.
Cymadusa filosa, 6

E–116, Engebi Island, ocean side, *Turbinaria ornata* algae attached to rocks at surge zone, Sept. 7.
Ampithoe ramondi, 1; *Hyale honoluluensis*, 8

E–118, Engebi Island, ocean side, algae on rocks at surge zone, Sept. 7.
Hyale honoluluensis, 9

E–119, Engebi Island, ocean side, rocks mixed with algae from surge zone, Sept. 7.
Cymadusa filosa, 1; *Elasmopus ?pseudaffinis*, 3

E–120, Engebi Island, ocean side, algae on surface of outer reef flat, Sept. 7.
Beaudettia palmeri, new genus, new species, 3; *Cymadusa filosa*, 1; *Paragrubia vorax*, 2

E–127, Engebi Island, lagoon side, algae and sand, Sept. 7.
Ampithoe ramondi, 10; *Elasmopus pseudaffinis*, 4

E–128, Engebi Island, lagoon side, coral rocks resting in sand, Sept. 7.
Ampithoe ramondi, 11; *Cymadusa filosa*, 1; *Elasmopus spinidactylus*, 6

E–129, Engebi Island, lagoon side, algae attached to rocks in tide pool, Sept. 7.
Ampithoe ramondi, 1; *Cymadusa filosa*, 4; *Elasmopus pseudaffinis*, 5

E–133, Aaraanbiru Island, lagoon side, sand from 5 feet of water, Sept. 11.
Lembos species (cf. *L. francanni*), 1

E–136, Bogen Island, channel side, algae attached to old coral heads in 5 feet of water, Sept. 12.
Cymadusa filosa, 4; *Elasmopus pseudaffinis*, 3; *Paragrubia vorax*, 1

E–137, Bogen Island, ocean side, algae *Caulerpa racemosa*, Sept. 12.
Elasmopus pseudaffinis, 8; *Eurystheus digitatus*, 4; *Maera hamigera*, 1; *Maera inaequipes serrata*, 1; *Maera insignis*, 4

E–138, Bogen Island, ocean side, cemented coarse coral sand, Sept. 12.
Maera ?insignis, 1

E–140, Bogen Island, ocean side, rocks, cemented coral sand rock, Sept. 12.
Elasmopus pseudaffinis, 1; *Hyale honoluluensis*, 7

E–142, Bogen Island, channel side, old coral heads in 5 feet of water, Sept. 12.
Elasmopus pseudaffinis, 1; *Eurystheus atlanticus*, 10

E–143, Parry Island, sediment bucket suspended for 22 days, collected Sept. 14.
cf. *Ampithoe ramondi*, 5

E–144, same as E–143, fouling organisms from wood block.
Ampithoe ramondi, 24

E–145, same as E–144, organisms from sediments in bucket.
Ampithoe ramondi, 9

June and July 1957

E–147, Parry Island, lagoon side by power plant, sand and worm tubes from 10 feet of water, June 29.
Leucothoe hyhelia, new species, 4

E–158, Parry Island, at small island toward Eniwetok Island, lagoon sand from 10–15 feet of water, June 30.
Leucothoe hyhelia, new species, 5

E–163, Bogombogo Island, ocean side, wash of old coral heads in about 1 foot of water, July 2.
Cymadusa filosa, 1; cf. *Lembos intermedius*, 1; *Maera hamigera*, 2

E-166, Bogombogo Island, ocean side, algal clumps in 1 foot of water, July 2.
cf. *Maera inaequipes serrata*, 1
E-169, Bogombogo Island, ocean side, intertidal sand, July 2.
Lembos species (cf. *francanni*), 1
E-171, Bogombogo Island, lagoon side, algae attached to old coral heads, July 2.
?*Ampithoe ramondi*, 14; *Cymadusa filosa*, 4; *Hyale honoluluensis*, 4
E-172, Bogombogo Island, lagoon side, old coral head washings and coral rock, July 2.
Ampithoe ramondi, 5; *Cymadusa filosa*, 8; *Lembos* species (cf. *francanni*), 3
E-182, Parry Island, lagoon opposite EMBL, coral washings, July 7.
Synopia variabilis, 1
E-184, Parry Island, lagoon opposite EMBL, old coral washings from 5 feet of water, July 8.
?*Ampithoe ramondi*, 4; *Elasmopus pseudaffinis*, 5

Family Lysianassidae

Azotostoma, new genus

Diagnosis: Mouthparts styliform, formed into a large ventral conical bundle; basal article of mandibular palp nearly as long as second article; lower lip with well defined mandibular processes, inner lobes absent; maxilla 1 with projecting but blunt inner plate, fringed apically with fine hairs, outer plate with about 7 or 8 distal teeth, palp apparently biarticulate, clavo-falciform, exceeding outer plate; maxilla 2 with both pairs together enclosing an imaginary hemispherical channel, inner plate medially expanded, hairy, outer plate much more slender; maxilliped with palp projecting only slightly beyond the large outer plate, inner plates styliform, reaching end of outer plate, palp with 4 articles, the second produced apically so that the third article is attached proximal to its apex, article 4 claw-shaped; gnathopod 1 simple, not subchelate, the sixth and seventh articles quite elongated and slender, article 7 serrate along its inner edge; gnathopod 2 minutely subchelate; coxae closely packed but first not strongly concealed by second; uropod 3 biramous; telson entire.

Type species: *Azotostoma fusta*, new species.

Relationship: This genus belongs with the *Trischizostoma-Acidostoma* group of lysianassids bearing styliform mouthparts formed into a concial bundle. The genus differs from *Stomacontion* and *Acontiostoma* by the biramous third uropods; from *Phoxostoma* by the well-developed fourth article of the maxillipedal palp; from *Trischizostoma* by the simple, styliform first gnathopod; from *Acidostoma* by the large palp of maxilla 1 and from *Shackletonia*, to which it bears closest relationship, by the uncleft telson. The genus assorts so many unusual features that it is not closely related to any other genus of lysianassid mentioned and is quite remarkable in the second maxillae and in the produced second article of the maxillipedal palp.

***Azotostoma fusta*, new species**

FIGURES 1, 2

Diagnosis: With the characters of the genus.

Notes: Third uropod with peduncle formed into a slight lateral plate; sixth article of gnathopod 2 with 4 large curved, bifurcate setae; eye large, dark, ommatidia quite large for the small head; pleonal epimera with quadrate lower posterior corners; urosomal segments strongly telescoped.

Holotype: USNM 106797, female, 2.1 mm.

Type locality: Abbott station 41–D–3, Ifaluk Atoll, Sept. 17, 1953.

Material: Abbott stations 41–D–3 (2), 42–F–2 (2), 46–E–2 (1), 58–F–2 (1), 66–E–10 (1), 102–B–2 (1), 122–C–1 (1).

Distribution: Ifaluk Atoll, Caroline Islands.

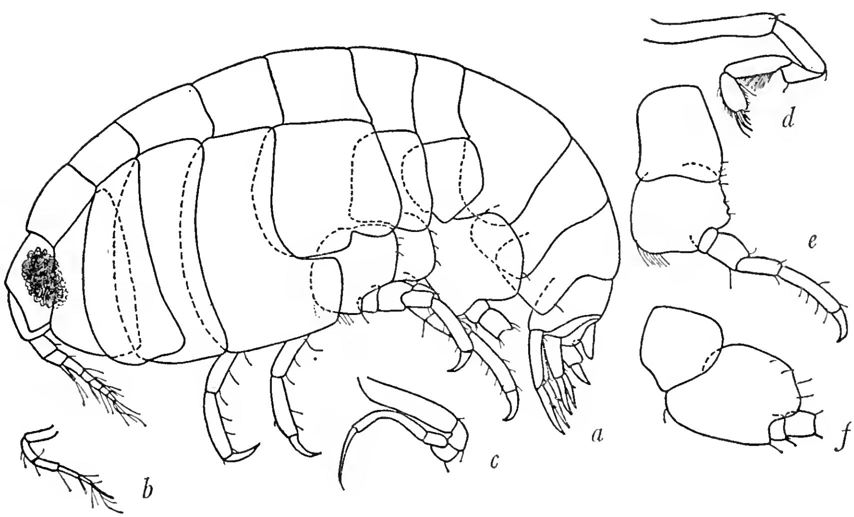

FIGURE 1.—*Azotostoma fusta*, new species, female, 2 mm., Abbott sta. 102-B-2: *a*, lateral view; *b*, antenna 2; *c*, *d*, gnathopods 1, 2; *e*, *f*, pereopods 4, 5.

Family Anamixidae

Genus *Anamixis* Stebbing

***Anamixis falarikia*, new spceies**

FIGURE 3

Diagnosis: Head partially fused with first pereonal segment, but a slightly movable articulation is present; head produced forward, with a sharp tooth for a lateral lobe; antenna 1 attached to apex of head, antenna 2 attached well behind lateral corner of head;

antenna 1 with a small distal tooth on article 1; coxa 1 apparently completely fused with pereonal segment 1, for no visible lamina is present; lower part of mouth area bearing a toothed lamina but it does not project as an epistome as in *Paranamixis bocki* Schellenberg (1938a); behind the lamina are 2 bilateral bulbs and behind these is the fully developed maxilliped, lacking any but vestigial inner plates; fourth maxillipedal palp article remarkably elongated and curved;

FIGURE 2.—*Azotostoma fusta*, new species, female, 2 mm., Abbott sta. 102-B-2: *a*, *b*, two views of uropod 3; *c*, telson; *d*, *e*, mandibles, two views; *f*, half of lower lip; *g*, *h*, maxillae 1, 2; *i*, maxilliped, dotted line is base of palp behind; *j*, palp of maxilliped; *k*, *l*, ends of gnathopods 1 and 2, enlarged.

opposing chelas of gnathopod 1 apically blunt and slightly bulbous, neither claw bearing an apical spine, seventh article (upper claw) with a toothed inner edge; coxa of gnathopod 2 broader than long, much larger than coxa 3, lower edge sinuous, article 2 with a distal tooth and bump, process of article 5 short in comparison with other species of the genus, article 6 broadly expanded, palm longer than hindmargin and cut into 6 teeth, article 7 apically bifid; second

articles of pereopods 3–5 only moderately expanded and lacking radial lines seen in other species of the genus; outer rami of uropods 1 and 2 quite short, about half the length of inner rami, uropod 3 missing; telson apically rounded.

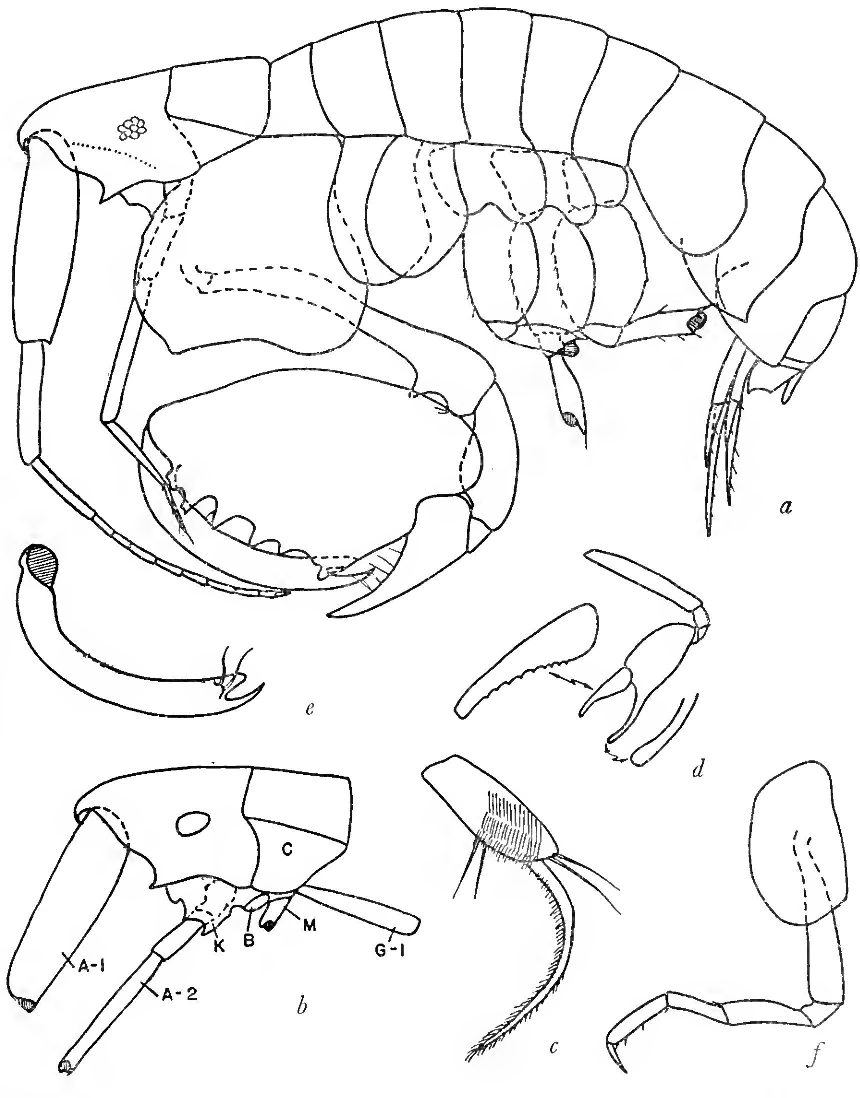

FIGURE 3.—*Anamixis falarikia*, new species, male, holotype, 2.2 mm., Abbott sta. 145-C-2: *a*, lateral view; *b*, view of head (A-1, A-2 = antennae; K = ventral keel; B = bi-lateral bulbs; M = base of maxilliped; C = lateral surface of peraeon segment 1 representing coxa 1; G-1 = base of gnathopod 1); *c*, last two articles of maxillipedal palp; *d*, gnathopod 1; *e*, finger of gnathopod 2; *f*, pereopod 1.

Holotype: USNM 105706, ?male, 2.2 mm, figured.

Type locality: Abbott station 145–C–2, Ifaluk Atoll, Oct. 21, 1953.

Material: The holotype and one specimen from Bayer station 465 C 1/4.

Relationship: This anamixed is unusual in the shape and ornamentation of its head, the long fourth palp article of the maxilliped, the broadly expanded palm of gnathopod 2 cut into large teeth and the apically bifid claw of gnathopod 2. As such, it bears no close relationship to the other species of the genus.

Instead of small dentitions on the dactyl of gnathopod 1, the other specimen from station 465 C 1/4 has small, short setae. This may be a growth stage or perhaps indicate a different sex.

Distribution: Ifaluk Atoll, Caroline Islands.

Anamixis stebbingi Walker

Figure 4

Anamixis stebbingi Walker, 1904, pp. 259–261, pl. 3, fig. 18.

Diagnosis: Head partially fused with first pereonal segment, but a slight, movable articulation is present; head not strongly produced forward as in *A. falarikia*, new species, bearing a sharp tooth for a lateral lobe, rostrum distinct from rest of head; antenna 1 attached behind apex of rostrum, distal end of article 1 not bearing a small tooth; lower part of mouth area bearing a lamina with a single acute tooth, not projecting as an epistome would; fourth maxillipedal palp article remarkably elongated and curved as in *A. falarikia;* opposing chelae of gnathopod 1 apically blunt and slightly bulbous, neither chela bearing an apical spine, seventh article (claw) with a toothed inner edge; coxa of gnathopod 2 longer than broad, not larger than coxa of pereopod 1, lower edge slightly sinuous, article 2 lacking a distal tooth or bump, process of article 5 long, article 6 narrow, palm not distinct, hind edge straight, bearing a distal tooth and a small subdistal serration, article 7 simple, not bifid, bearing a single inner protuberance; second articles of pereopods 3–5 slightly more expanded than in *A. falarikia*, with faint radial lines; outer rami of uropods 1–2 quite short, about half the length of the inner rami, uropod 3 missing; telson apically rounded.

Material: Abbott stations 145–C–2 (1), 177–G–5 (1).

Remarks: This was the second species of the genus described and differs from the type species, *A. hanseni*, by the lack of apical spines on the chelae of gnathopod 1 and the single, not double protuberance on the claw of gnathopod 2. The first coxa is seen as a distinct lateral plate produced forward into a bifid apex.

The specimen from station 177–G–5 bears small setae, not teeth on the inner edge of the claw on gnathopod 1. This may indicate a difference in sex as suggested also in the case of *A. falarikia*, new species, where the two known specimens differ in the same way.

Distribution: Ceylon; Ifaluk Atoll, Caroline Islands.

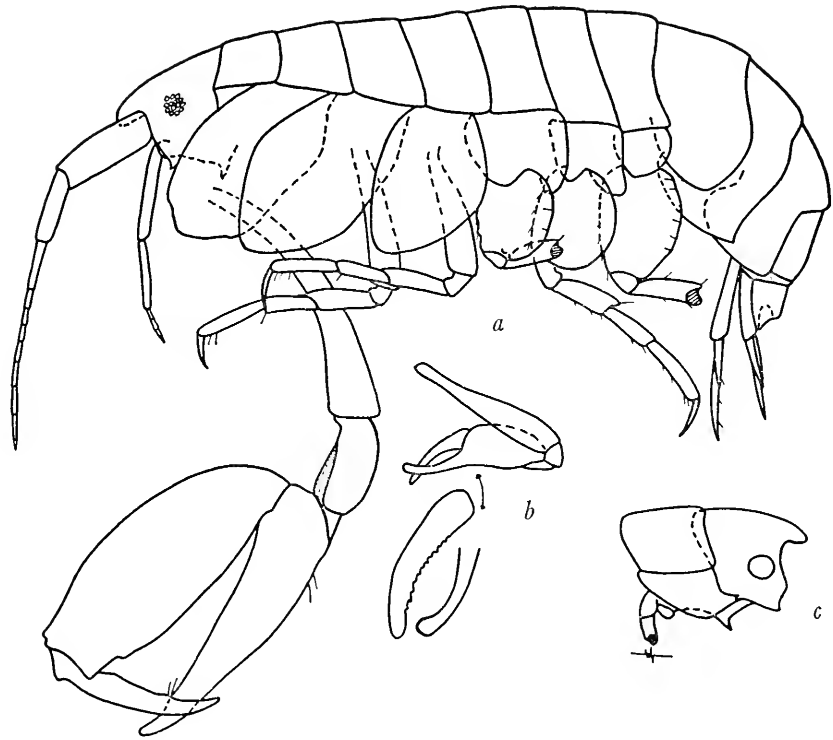

FIGURE 4.—*Anamixis stebbingi* Walker, ?male, 2 mm., Abbott sta. 145-C-2: *a*, lateral view; *b*, gnathopod 1 with ends of chelae enlarged; *c*, head showing projection of ventral keel.

Family Leucothoidae

Genus *Leucothoe* Leach

Leucothoe hyhelia, new species

FIGURE 5

Diagnosis: Article 3 of antenna 1 less than a third as long as article 1; lateral lobes of head rounded, not acute; telson pointed apically; article 2 of pereopod 5 subquadrate, rather expanded; second pleonal epimeron with small tooth at lower posterior corner, third epimeron quadrate, not produced, with softly rounded corner;

palms of gnathopods in both sexes nearly smooth, female smoother than male, sparsely serrate, the serrations larger near finger hinge; gnathopod 1 moderately slender, article 6 evenly expanded throughout, article 7 less than one fourth as long as article 6; eyes round. Mouthparts like *L. spinicarpa* figured by Sars (1895, pl. 100).

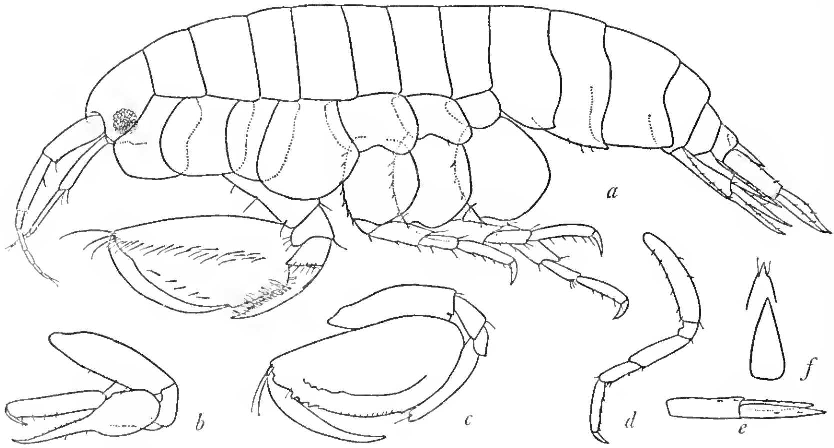

FIGURE 5.—*Leucothoe hyhelia*, new species, holotype, male, 3.4 mm., Reish sta. E-158: *a*, lateral view; *b*, *c*, gnathopods 1, 2, with inset of palmar edge of a female second gnathopod in fig. *c*; *d*, pereopod 2; *e*, uropod 3; *f*, telson.

Holotype: USNM 107574, male, 3.4 mm.

Type locality: Reish station E–158, Parry Island, Eniwetok Atoll, June 30, 1957.

Material: Reish stations E–147 (4), E–158 (5).

Relationship: This species differs from *Leucothoe tridens* Stebbing (1888, pl. 47) by the broader second article of pereopod 5, the small point at the apex of the telson, the much shorter third article of the first antenna. It differs from *Leucothoe spinicarpa* (in Sars 1895, pls. 100, 101, fig. 1) by the broader and more quadrate second article of pereopod 5, the unevenly and sparsely denticulate palm of the second gnathopods in both sexes, and the shorter finger of gnathopod 1. The new species and the two mentioned above are perhaps the most closely related trio in the genus but the differences seem to be uniform.

Distribution: Eniwetok Atoll.

Leucothoe micronesiae, new species

FIGURE 6

Diagnosis: Article 3 of antenna 1 about 40% as long as article 2; article 6 of gnathopod 1 widest at its base, tapering to a blunt point,

not serrate on inner edge, article 7 very short; article 6 of second gnathopod 1.6 times as long as broad, palm oblique, bearing a blunt tooth at finger hinge, proximal to which is another tooth, separated by a small sinus, then a prominent tooth near defining corner of palm, separated from the more distal tooth by a wide, flat sinus, defining corner indistinctly bifurcate; gnathopods variable in palmar armature with another configuration on left side of holotype having the process at finger hinge and the next proximal much closer together and an additional medial tooth, with tooth near defining corner smaller and bifurcation at corner obsolescent; telson short, apically tridentate.

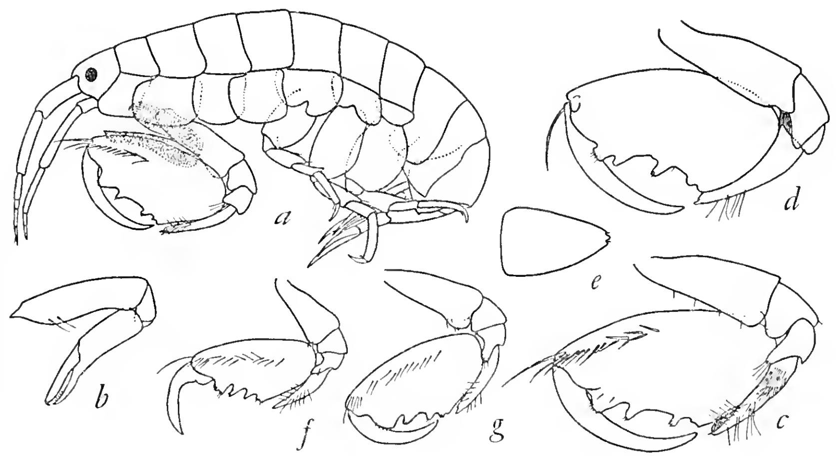

FIGURE 6.—*Leucothoe micronesiae*, new species, holotype, female, 2.5 mm., Abbott sta. 155-157-G-1: *a*, lateral view; *b*, gnathopod 1; *c*, *d*, medial and lateral views of gnathopod 2; *e*, telson; specimens of unknown sex, 1.0, 1.3 mm., Abbott sta. 179-184-M-1: *f*, *g*, second gnathopods.

Holotype: USNM 106805, ovigerous female, 2.5 mm.

Type locality: Abbott station 155–157–G–1, Ifaluk Atoll, Oct. 23, 1953.

Material: Abbott stations 122–C–1 (2), 155–157–G–1 (3), 177–G–5 (1), 179–184–M–1 (2); Bayer station 467 (8).

Relationship: This species may represent the female and young of *Leucothoe minuscula* Schellenberg (1938a), although it would have to be considerably better developed than the female figured by Schellenberg; the male of that species has article 6 of the second gnathopod 2.3 times as long as wide, thus considerably longer than in the present females; only for such a reason have I decided to erect this new species.

This species is related also to *L. brevidigitata* Miers (see *L. flindersi* Stebbing, 1888) because of the short dactyl of gnathopod 1 but differs by the sixth article being broad at its base whereas in *L. brevidigitata* it is narrow at the base.

Chilton (1923) fused *L. brevidigitata* with *L. spinicarpa* but I believe it should be resurrected on the basis of the small dactyl of gnathopod 1.

This new species bears resemblance to *L. hornelli* Walker (1904) (=*L. furina* Savigny by Schellenberg, 1928) in the structure of the gnathopodal palm but differs by the short dactylus of gnathopod 1. It also resembles *L. stegoceras* Walker (1904) but according to his comparison with *L. spinicarpa* that species also has a long dactylus of gnathopod 1 and thus would be specifically distinct from the new species.

Distribution: Ifaluk Atoll, Caroline Islands.

Leucothoe tridens Stebbing

Leucothoe tridens Stebbing, 1888, p. 777, pl. 47; 1906, p. 166.

?*Leucothoe tridens*.—Chilton, 1906, p. 268.—Schellenberg, 1938a, pp. 21–23, fig. 11.

?*Leucothoe tridens recifensis* Schellenberg 1938b, pp. 205–206.

Material: Abbott stations 50–E–1 (1), 160–165–J–5 (1).

Remarks: These specimens together fit Stebbing's figures very closely, but those parts missing on one specimen had to be confirmed on the other specimen. Unlike Schellenberg's (1938a) figure the lateral head lobes are rounded, not acute. Stebbing's figure is not wholly clear on this point.

Distribution: New Zealand, 2000 m. (questionable type locality); ?Auckland, New Zealand, 25 fms.; ?Gilbert Islands; ?Philippines; ?Brazil; ?Ifaluk Atoll, Caroline Islands.

Genus *Leucothoella* Schellenberg

Leucothoella bannwarthi Schellenberg

Figure 7

Leucothoella bannwarthi Schellenberg, 1928, pp. 638–640, fig. 199.—K. H. Barnard, 1937, p. 153.—Schellenberg, 1938a, p. 26.

Material: Abbott stations 99–F–3 (2), 113–H–2 (2), 116–F–3 (1).

Remarks: Although the first coxa is not as strongly serrate as noted by Schellenberg (1928), the writer finds no other major differences from that original description and assigns these specimens thereto.

Distribution: Suez; Red Sea; Philippines; Ifaluk Atoll, ?Caroline Islands; Marshall and Fiji Islands.

Genus *Leucothoides* Shoemaker

Leucothoides pottsi Shoemaker

Leucothoides pottsi Shoemaker, 1933, pp. 249–250, fig. 3.—Schellenberg, 1938a, pp. 26–28, fig. 13.—Ruffo, 1959, p. 2, pl. 1, figs. 1, 2.

Material: Abbott stations 41–D–3 (1), 158–159–D–5 (1), 160–165–J–5 (1), 177–G–5 (2); Bayer stations 465 C 1/4 (1), 467 (1); 594 (3).

Distribution: Dry Tortugas, Caribbean Sea; Gilbert and Marshall Islands; Ifaluk Atoll, Caroline Islands.

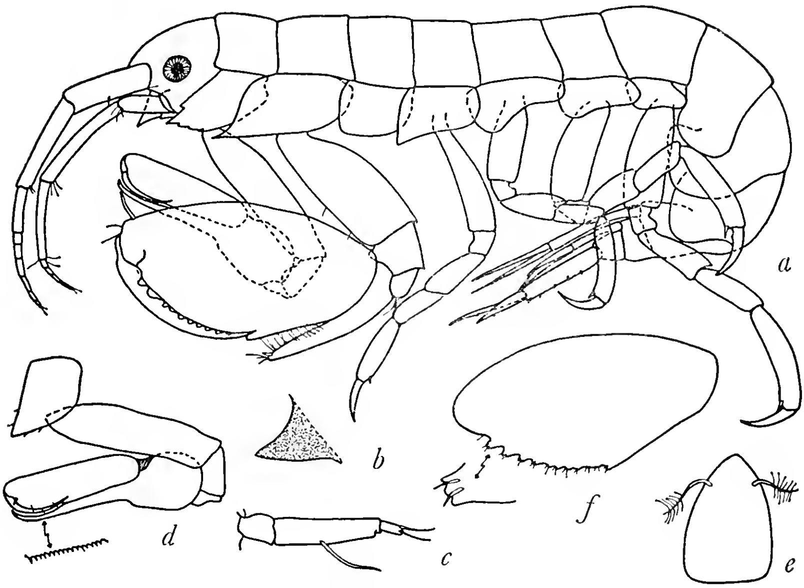

FIGURE 7.—*Leucothoella bannwarthi* Schellenberg, male, 2.5 mm., Abbott sta. 113-H-2: *a*, lateral view; *b*, epistome; *c*, mandibular palp; *d*, gnathopod 1; *e*, telson; *f*, gnathopod 2.

Family Colomastigidae

Genus *Colomastix* Grube

Colomastix pusilla Grube

Colomastix pusilla Grube.—J. L. Barnard 1955, pp. 39–42, fig. 20 (with references).

Material: Abbott stations 113–H–2 (2), 116–F–3 (1), 122–C–1 (1), 209–F–4 (1); Bayer stations 467 (9), 594 (4), 670 (1), 709 (3), 756 (5).

Distribution: Pantropical and warm temperate.

Family Pontogeneiidae

Ronco, new genus

Diagnosis: Mandibular palp slender; upper lip bilobed, epistome unproduced; inner plate of maxilla 1 poorly setose, slender, inner plate of maxilla 2 slender, not setose on inner edge, outer plate twice as wide as inner plate; accessory flagellum vestigial but composed of one long article; lower lip with well-developed inner lobes; gnathopods not linear, sixth articles expanded, fifth articles with hindlobes; antenna 1 longer than 2; telson split more than half its length.

Type species: *Ronco sosa*, new species.

Relationship: This genus is closely related to *Pseudomoera* Schellenberg (1929), of which the unique type species is *P. gabrieli* (Sayce 1901) described from Australian freshwaters at an altitude of 1500 feet. *Ronco* differs from *Pseudomoera* in its bilobed upper lip, its slender mandibular palp, and the unequal lobes of maxilla 2.

It differs from *Paramoera* Miers by the poorly setose inner plate of maxilla 1 and the well-developed inner lobes of the lower lip and from *Djerboa* Chevreux by the lack of an accessory claw on pereopods 1–5 and the nonlinear gnathopods.

It is especially related to *Eusiroides* Stebbing, differing only by the strongly bilobed upper lip. Species of *Eusiroides* bear very stout spines on the gnathopodal palms.

Ronco sosa, new species

Figure 8

Diagnosis: With the characters of the genus.

Descriptive notes: The eyes are quite large and black, with the side lobes of the head broadly rounded in front, not notched; rostrum small; upper lip notched; pereopods 1 and 2 with a large distal spine on article 6; third pleonal epimeron quadrate behind.

Holotype: USNM 106871, male, 2.2 mm.

Type locality: Abbott station 31–D–2, Ifaluk Atoll, Sept. 4, 1953.

Material: Abbott stations 31–D–2 (1), 160–165–J–5 (1); Bayer station 638 (1).

Distribution: Ifaluk Atoll, Caroline Islands.

Family Synopiidae (incl. Tironidae)

Synopia variabilis Spandl

Figure 9

Synopia variabilis Spandl, 1923 [not seen].—Spandl, 1924, pp. 48–50, fig. 17a–g.

Material: Abbott station 194–E–2 (2); Reish stations E–52 (12), E–182 (1).

Distribution: Red Sea; Ifaluk and Eniwetok Atolls.

Family Gammaridae

Paraceradocus micramphopus Stebbing (1910a) should be transferred to the genus *Metaceradocus* Chevreux (1925), of which it forms the third species.

Genus *Elasmopus* Costa

A key to this genus is presented on pages 497–498. The following species are omitted:

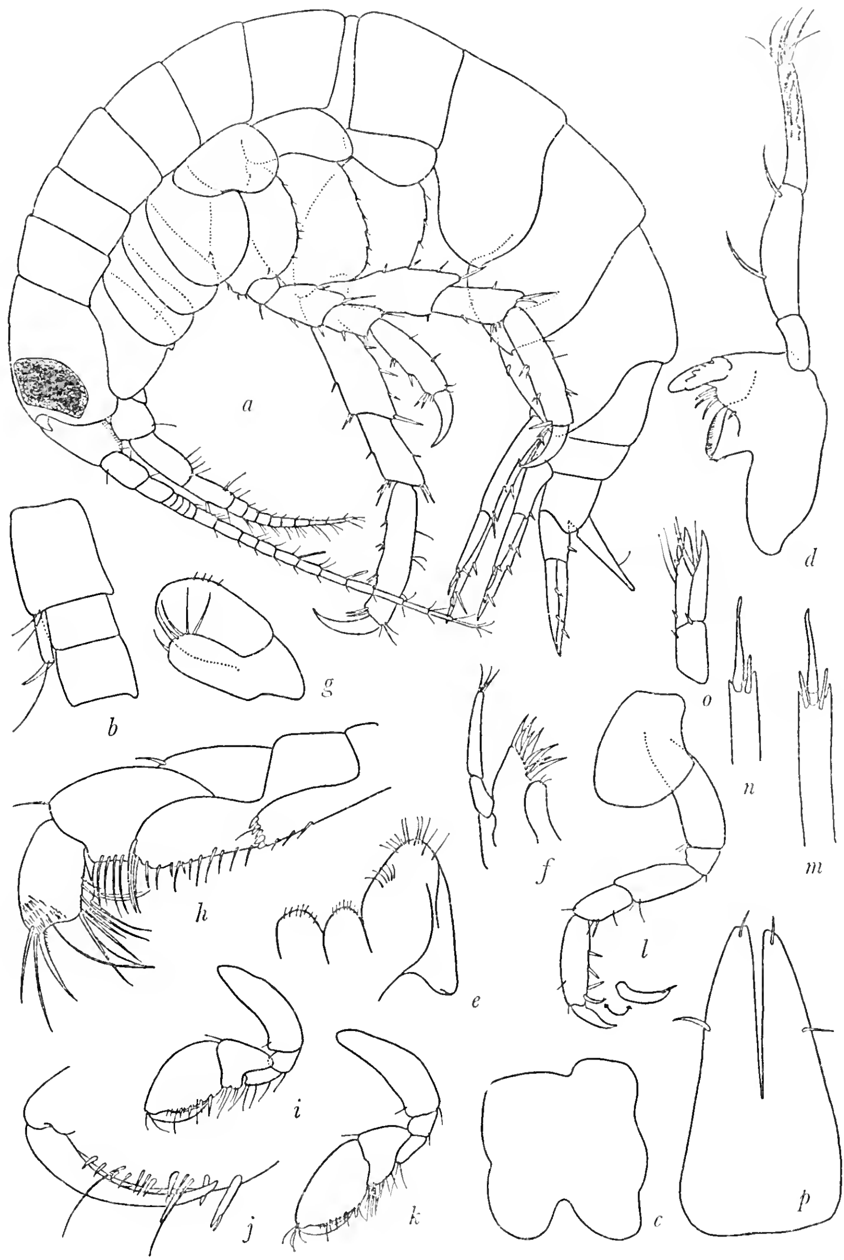

FIGURE 8.—*Ronco sosa*, new species, holotype, male, 2.2 mm., Abbott sta. 31-D-2: *a*, lateral view; *b*, part of antenna 1 showing accessory flagellum; *c*, upper lip; *d*, mandible; *e*, lower lip with one outer lobe missing; *f*, *g*, maxillae 1, 2; *h*, maxilliped; *i*, *j*, gnathopod 1; *k*, gnathopod 2; *l*, pereopod 2; *m*, *n*, ends of rami of uropod 2; *o*, uropod 3; *p*, telson.

Elasmopus atolgidus, new species: 1 female (see diagnosis for special features).

Elasmopus besnardi Oliveira (1951): a female (perhaps a synonym of *E. brasiliensis* (Dana)).

Elasmopus brasiliensis (Dana): Oliveira's (1951) reference and figures of this species are those of *E. pectenicrus* (see discussion in text).

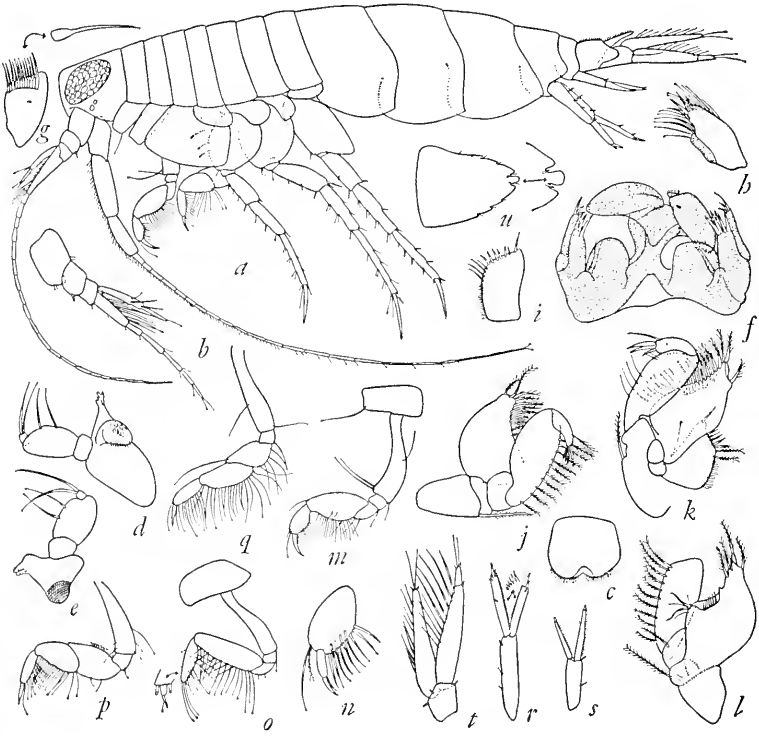

FIGURE 9.—*Synopia variabilis* Spandl, male, 3.8 mm., Abbott sta. 194-E-2: *a*, lateral view; *c*, upper lip; *d*, *e*, mandibles; *f*, complex of first maxillae and lower lip; *g*, *h*, plates of maxilla 1; *i*, inner plate of maxilliped; *j*, *l*, maxilliped, lateral views; *m*, *o*, gnathopods 1, 2; *p*, *q*, pereopods 1, 2; *r–t*, uropods 1, 2, 3: *u*, telson; female, 2.7 mm.: *b*, antenna 1; *k*, maxilliped; *n*, end of gnathopod 1.

Elasmopus caprai Maccagno (1936): no figures (drawings of male gnathopod 2 needed).

In addition, the following notes must be considered:

Elasmopus delaplatus Stebbing (1888) is cited twice in couplets 17 and 28 because of uncertainty about the defining palmar process on male gnathopod 2.

Elasmopus levis Smith is the species considered in couplet 8 and not the homonym *E. levis* K. H. Barnard (1916) which has been renamed *E. vagans* by K. H. Barnard (1940).

Elasmopus chevreuxi Cecchini (1928): both Schellenberg (1938a) and Ruffo (1959) refer this to *E. brasiliensis*.

References to all species may be consulted in J. L. Barnard's index (1958) except:

E. rapax mutatus and *E. holgurus:* both described by J. L. Barnard (1962b).

The following species should be transferred to *Maera* Leach: *Elasmopus latibrachium* Walker (1905), *E. smirnovi* Bulycheva (1952), and *E. sokotrae* Walker and Scott (1903).

Key to Males of *Elasmopus*

1. Some body segments dorsally dentate 2
   No body segments dorsally dentate 5
2. Four segments dorsally dentate 3
   One segment dorsally dentate 4
3. Gnathopod 2, palm very oblique . . . . **E. diemenensis**
   Gnathopod 2, palm nearly transverse . . . . **E. suensis**
4. Article 2 of pereopod 5 alate, proximally widened . . . . . **E. neglectus**
   Article 2 of pereopod 5 normally oval . . . . **E. japonicus**
5. Gnathopod 2, palm transverse . . . . **E. dubius**
   Gnathopod 2, palm oblique 6
6. Right and left second gnathopods differing in structure . . . . **E. bollonsi**
   Right and left second gnathopods alike in structure. 7
7. Palm of gnathopod 2 with a large cuplike medial hollow 8
   Palm of gnathopod 2 lacking medial cuplike hollow 9
8. Medial apex of each telsonic lobe rounded . . . . **E. pocillimanus**
   Medial apex of each telsonic lobe sharp . . . . **E. levis**
9. Palm of gnathopod 2 lacking major teeth, tubercles or processes 10
   Palm of gnathopod 2 bearing teeth, tubercles or with a blunt process near finger hinge 15
10. Palm of gnathopod 2 distinct and defined either by a stout articulated spine or by a sharp palmar corner 11
    Palm of gnathopod 2 not distinctly defined 12
11. Gnathopod 2, palm defined by a stout spine, no other stout spines present . . . . **E. magnispinatus**
    Gnathopod 2, palm defined by a sharp corner, palm and hindmargin of article 6 furnished with additional spines . . . . **E. steinitzi**
12. Dactylus of pereopods 1–2 with 2 nails, article 6 with a stout distal spine . . . . **E. diplonyx**
    Dactylus of pereopods 1–2 with one or no nail, article 6 lacking a stout distal spine 13
13. Gnathopod 2, part of palm minutely crenulated . . . . . **E. dentiferus**
    Gnathopod 2, palm not minutely crenulated 14
14. Articles 6–7 of gnathopod 2 quite elongated, article 7 sinuous . . **E. gracilis**
    Articles 6–7 of gnathopod 2 not elongated, article 7 not sinuous. **E. brasiliensis**

15. Palm of gnathopod 2 bearing defining tooth 16
Palm of gnathopod 2 lacking defining tooth 21
16. Gnathopod 2 with teeth besides defining one. 17
Gnathopod 2 only with defining tooth. . . . . **E. minimus**
17. Palm of male gnathopod 2 bearing 2 teeth . . . . . **E. delaplata** (in part)
Palm of male gnathopod 2 bearing 3 or more teeth 18
18. Palmar hinge tooth of male gnathopod 2 armed with spines 19
Palmar hinge tooth of male gnathopod 2 not armed with spines. **E. calliactis**
19. Middle palmar tooth of male gnathopod 2 broadly and asymmetrically subconical . . . . **E. holgurus**
Middle palmar tooth of male gnathopod 2 narrowly conical or columnar. . 20
20. Article 2 of pereopods 3–5 bearing long setae behind, accessory flagellum 2 or more articulate . . . . **E. rapax**
Article 2 of pereopods 3–5 lacking long setae behind, accessory flagellum uni-articulate . . . . **E. rapax mutatus**
21. Dactyli of pereopods bearing lines of small erect, blunt teeth. **E. spinidactylus**
Dactyli of pereopods smooth or bearing articulated setae 22
22. Apices of telson broadly rounded, not spinose . . . . **E. affinis**
Apices of telson subacute, truncate, notched, convex and/or spinose . . . 23
23. Article 2 of pereopod 4 with a fluted and crenulated posterodistal excavation. **E. pectenicrus**
Article 2 of pereopod 4 oval, serrate normally 24
24. Palm of gnathopod 2 heavily setose. 25
Palm of gnathopod 2 not heavily setose 29
25. Third pleonal epimeron quadrate behind 26
Third pleonal epimeron with a small posterodistal tooth. 27
26. Pereopod 5, anterior edge of article 4 produced downward . **E. ecuadorensis**
Pereopod 5, anterior edge of article 4 not produced . . . . . **E. perditus**
27. Pereopod 5, anterior edge of article 4 produced downward strongly. **E. delaplata** (in part)
Pereopod 5, anterior edge of article 4 not produced downward 28
28. Gnathopod 2, process near finger hinge bearing stout spines . . **E. buchneri**
Gnathopod 2, process near finger hinge lacking stout spines . **E. antennatus**
29. Palm of gnathopod 2 with 3 processes. . . . . **E. erythraeus**
Palm of gnathopod 2 with 2 processes. . . . . **E. pseudaffinis**
Palm of gnathopod 2 with one process 30
30. Palm of gnathopod 2 lined with stout spines its full length . . **E. spinimanus**
Palm of gnathopod 2 lacking spines or with spines restricted to a group . . 31
31. Gnathopod 2, middle of palm with rod-like process . . . . . **E. excavatus**
Gnathopod 2, palm bearing only a short, broad process near hinge. **E. fusimanus**

Elasmopus atolgidus, new species

FIGURE 10

Diagnosis of female: Eyes large, black; accessory flagellum composed of two articles tipped with a minute third; pereopods 1–2 bearing 2 large curved distal spines on sixth articles, article 7 with distal claw scarcely distinct, but bearing 3 minute setules; posterior edge of third pleonal epimeron slightly convex, lower corner rounded, except for

a minute notch; no segments with dorsal teeth; telson with rounded apices, no lateral notches, each lobe with a spine about halfway to base; gnathopod 1 unusually stout; gnathopod 2 with oblique palm and microscopic translucent ridge along distal half.

Holotype: USNM 106877, ovigerous female, 3.5 mm. Unique.

Type locality: Abbott station 23–E–2, Ifaluk Atoll, Sept. 4, 1953.

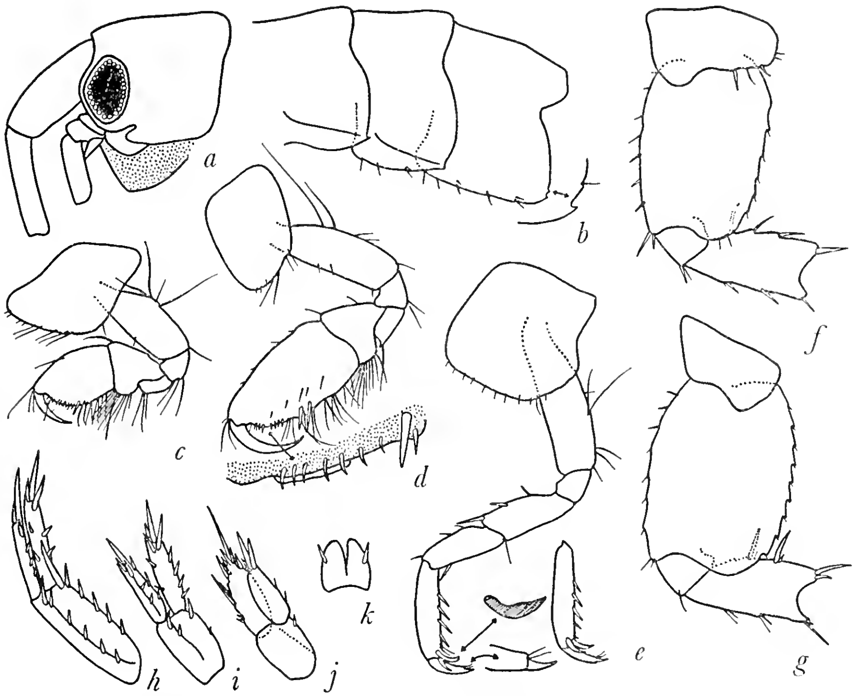

FIGURE 10.—*Elasmopus atolgidus*, new species, holotype, female, 3.5 mm., Abbott sta. 23-E-2: *a*, head; *b*, pleon segments 1–3; *c*, *d*, gnathopods 1, 2; *e*–*g*, pereopods 2, 4, 5; *h*–*j*, uropods 1, 2, 3; *k*, telson.

Relationship: This single specimen is so unique to the atoll collections that it is worthy of description, despite its slightly damaged condition and the fact that it is a female. The species needs distinction from only two others described, because of the combination of large eyes, spines on pereopods 1–2, and the unusual configuration of the telson (usually with lateral notches or truncate, spinose apices in *Elasmopus*). The new species is related to *E. diplonyx* Schellenberg (1938a) by the stout spines of pereopods 1–2; Schellenberg described *E. diplonyx* with one distal spine; the second spine in the new species is easily overlooked because it does not project but overlies the dactylus; however, the apically incised telson and stout dactylar spine of *E. diplonyx* are distinctive.

Elasmopus atolgidus is also related to *E. perditus* Reid (1951, western Africa), described as a unique male. Specifically the new species differs only by the fact that Reid stated that the telsonic spines were apical whereas in the present species they are considerably subapical. Until males of the new species and females of *E. perditus* can be compared no other distinctions can be stated.

Distribution: Ifaluk Atoll, Caroline Islands.

Elasmopus brasiliensis (Dana)

FIGURE 11

Elasmopus brasiliensis (Dana).—Stebbing, 1906, p. 443 (in part, not *E. pectenicrus*).—Chevreux, 1911, pp. 222–225, fig. 12, pl. 15 (figs. 14–20).

Other references with unverified identification:

Elasmopus brasiliensis (Dana).—Stebbing, 1917a; Poisson and Legueux, 1926; Chevreux, 1927; Alderman, 1936; Ruffo, 1938; Shoemaker, 1942; Ruffo, 1947.

not *Elasmopus brasiliensis* (Dana).—Oliveira, 1951, pp. 4–10, pls. 1–4, figs. 1–30 (=*E. pectenicrus* [Bate]).

Material: Abbott stations 87–H–2 (7), 89–F–3 (11), 95–L–4 (2), 95–O–4 (3).

Remarks: No satisfactory topotypic reidentification of *Elasmopus brasiliensis* (Dana) has been made since its original description. The type locality is Rio de Janeiro. Bate (1862) simply copied Dana's original description and a figure, then proceeded to describe on a later page *Moera* [sic] *pectenicrus* with type locality of New Guinea.

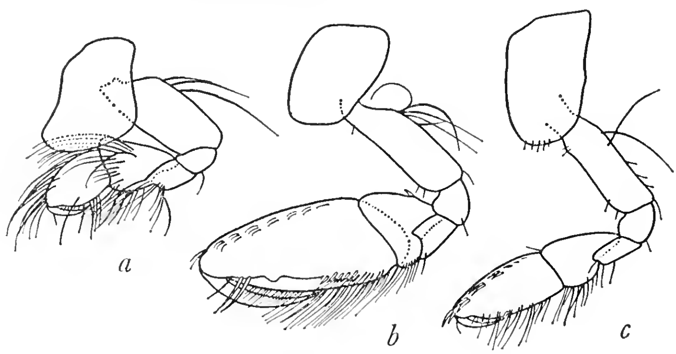

FIGURE 11.—*Elasmopus brasiliensis* (Dana), male, 3 mm., Abbott sta. 89-F-3: *a*, *b*, gnathopods 1, 2; female, 3 mm.: *c*, gnathopod 2.

In 1906 Stebbing fused the two species, although Dana's and Bate's figures of the two are different; however, Dana's figure and description were quite plain and could have contained errors. In 1911 Chevreux described and figured specimens from Algeria fitting Dana's species because of the same plainness; however, Algeria is far removed from the type locality of *E. brasiliensis*. In 1916 K. H. Barnard resurrected *E. pectenicrus*, pointing out Chevreux's (1911)

paper and stating that *E. pectenicrus* should be separated from *E. brasiliensis*. Since that time only a few largely Mediterranean identifications of *E. brasiliensis* have been published while many have been recorded for *E. pectenicrus*. In 1951 Oliveira redescribed *E. brasiliensis* from Brazilian material, along with two other species described as new. Although she mentioned *E. pectenicrus* in a key concerning antennae, she must have overlooked the fact that the material of *E. brasiliensis* she redescribed was precisely *E. pectenicrus*. Her failure to discuss this question was unfortunate. If Chevreux's (1911) description did not exist, then one might automatically re-synonymize *E. pectenicrus* with *E. brasiliensis*, on the basis that Oliveira discovered it in the type locality; but one cannot consider that the search has been exhausted, since an animal from Algeria fits the description better. In addition, Oliveira's *Elasmopus besnardi*, apparently based on a female from Trinidad, could also be *E. brasiliensis*, despite an obviously poor figure of the animal. Perhaps it is a female corresponding to Chevreux's redescription. Thus, the question is not solved, especially in the lack of ecological information as to abundances and sizes (probing the probability Dana might have caught the largest or most abundant species), and the fact that Oliveira included Chevreux's (1911) reference to *E. brasiliensis*, while failing to note the very great differences between the two collections.

The material at hand corresponds well with that figured by Chevreux (1911), except that adults are only 3 mm. in length, half the size of those from Algeria; the hindmargin of the third pleonal epimeron is straighter and the lower tooth slightly smaller than figured by Chevreux. Close observation of the male second gnathopod shows a pair of large spines at the distal end of the inner face of the palm, not shown by Chevreux, plus a medial ridge of chitin having a small bump about halfway along the palm. These gnathopodal characteristics should be rechecked on Algerian material and on topotype materials, when available.

Distribution: This is the first record of the species from the Pacific Ocean. Known previously from Brazil, Mediterranean, South Africa.

Elasmopus excavatus Schellenberg

Elasmopus excavatus Schellenberg, 1938a, pp. 58–59, fig. 30.

Material: Abbott station 90–C–4 (1).

Distribution: Gilbert Islands; Ifaluk Atoll, Caroline Islands.

Elasmopus pseudaffinis Schellenberg

FIGURES 12, 13

Elasmopus pseudaffinis Schellenberg, 1938a, pp. 53–54, fig. 25.

Material: Abbott stations 28–D–3 (2), 30–C–4 (2), 39–E–5 (3), 57–E–2 (1), 58–F–2 (3), 60–D–1 (1), 66–E–10 (3), 70–C–3 (1), 72–G–3 (2),

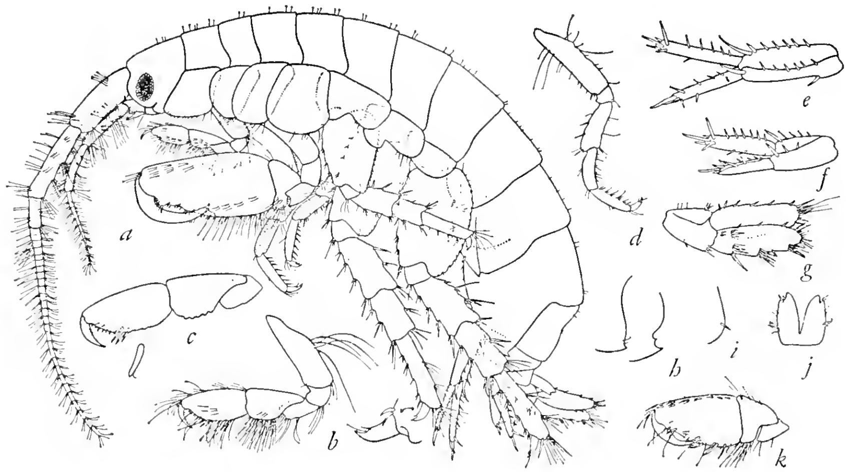

FIGURE 12.—*Elasmopus pseudaffinis* Schellenberg, male, 9 mm., Reish sta. E-93: *a*, lateral view; *b*, *c*, gnathopod 1; *d*, pereopod 1; *e–g*, uropods 1, 2, 3; *h*, third pleonal epimeron of notched form with enlargement to the right; *i*, lower hindcorner of coxae 1–3; *j*, telson; male, 2.0 mm., sta. 85-F-3: *k*, gnathopod 2.

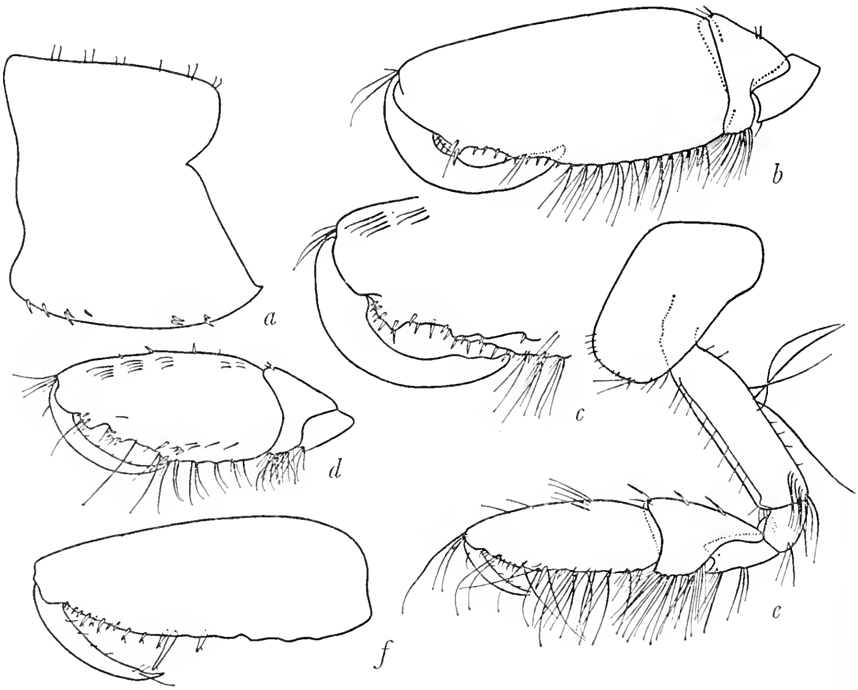

FIGURE 13.—*Elasmopus pseudaffinis* Schellenberg, male, 9 mm., Reish sta. E-93: *a*, third pleonal epimeron; *b*, *c*, gnathopod 2, lateral and medial views; male, 5 mm.: *d*, gnathopod 2, medial view; female, 6 mm.: *e*, *f*, gnathopod 2.

76–H–3 (1), 83–E–1 (3), 84–D–1 (2), 85–F–3 (2), 95–D–4 (2), 95–L–4 (1), 125–D–3 (1), 128–C–5 (2), 130–C–2 (4), 132–E–4 (1), 139–C–2 (7), 141–D–3 (1), 142–E–4 (6), 146–151–H–4 (2), 155–157–G–1 (5), 158–159–D–5 (1); Hand station CH–682 (1); Bayer station 756 (1); Reish stations E–2 (1), E–18 (8), E–24 (3), E–26 (2), E–27 (1), E–38 (1), E–40 (1), E–43 (1), E–44 (2), ME–56 (1), ME–57 (2), E–68 (1), E–75 (6), E–78 (5), E–86 (1), E–93 (15), E–96 (1), BE–100 (3), BE–102 (5), BE–103 (6), BE–104 (4), BE–107 (4), BE–109 (1), BE–111 (38), E–119 (3), E–127 (4), E–129 (5), E–136 (3), E–137 (8), E–140 (1), E–142 (1), E–184 (5).

Remarks: This species is most variable and it has been difficult to resolve the impression that not all of the material so listed belongs to this species. The third pleonal epimeron in well-developed males takes the shape of figure 12 A, with a straight hindedge and small, nearly upturned tooth at the lower corner. Younger males, still with the correct gnathopodal configuration may have the lower corner rounded-quadrate, with or without a notch at the lower corner as figured by Schellenberg (1938a). Females and juveniles generally have a rounded or notched lower corner. Females are indistinguishable from *Elasmopus minimus* Chevreux (1908) and Pirlot (1936) but all males, where associated with the females, have the gnathopods of *E. pseudaffinis*. No *E. minimus* males have been found in the collections.

The notches of the third pleonal epimeron often have a small sharp tooth enclosed.

Some of the females actually may be young *E. rapax*, but only one recognizable male of that species has been found in the collections from the USNM. Except in large specimens, the teeth on the hindedges of the second articles of pereopods 3–5 are small and relatively even.

Distribution: Gilbert Islands; Kapingamarangi Atoll; Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Majuro Atoll, Bikini Atoll, Marshall Islands.

Elasmopus rapax Costa

Figure 14

Elasmopus rapax Costa.—J. L. Barnard, 1955, pp. 10–12, fig. 5.

Material: Abbott station 42–F–2 (2).

Remarks: The male at hand is more typical of the classic figures of this species (Sars, 1895, pl. 183) than the material reported by J. L. Barnard (1955) from the Hawaiian Islands. The large outer palmar tooth seen on the Hawaiian specimens is absent.

Distribution: Cosmopolitan tropical-temperate.

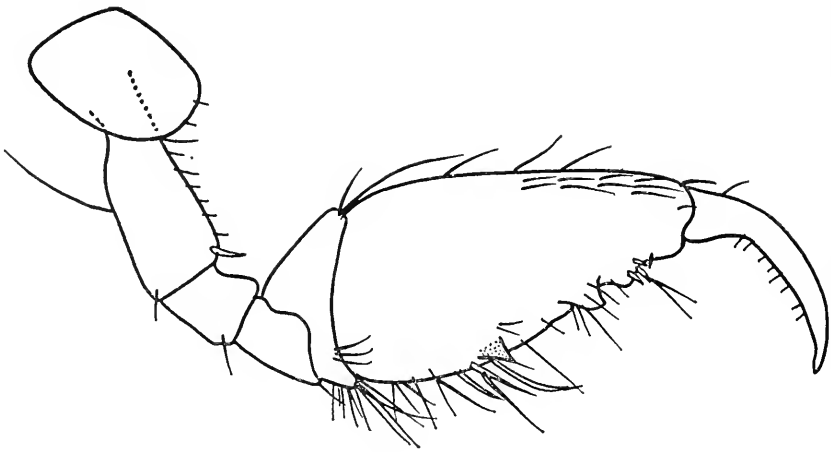

FIGURE 14.—*Elasmopus rapax* Costa, male, 3.2 mm., Abbott sta. 42-F-2: gnathopod 2, medial view.

Elasmopus spinidactylus Chevreux

Elasmopus spinidactylus Chevreux, 1907, pp. 413–414; 1908, pp. 486–489, fig. 9.—Walker, 1909, pp. 336–337.—Schellenberg, 1938a, p. 55.—Shoemaker, 1942, p. 13.—Ruffo, 1954, p. 119.

Material: Abbott stations 13–C–1 (8), 14–B–3 (14), 18–E–4 (1), 24–C–1 (9), 29–C–1 (3); Reish stations E–26 (5), E–73 (13), E–76 (1), E–77 (10), E–93 (8), E–94 (11), E–95 (6), E–96 (1), BE–101 (35), BE–108 (2), BE–112 (20) BE–113 (21), E–128 (6).

Distribution: Gambier and Tuamotu Archipelagos; Chagos Islands; Clipperton Island; Venezuela; Ifaluk Atoll, Caroline Islands; Bikini and Eniwetok Atolls, Marshall Islands.

Liagoceradocus, new genus

Diagnosis: Telson deeply cleft; accessory flagellum 2-articulate; pereonal and pleonal segments neither dorsally carinate nor toothed, nor spinose; rami of uropod 3 much longer than peduncle, not foliaceous, subequal in length, outer ramus biarticulate; inner edges of inner plates of both maxillae lined with setae; lower lip lacking inner lobes; palp article 3 of mandible longer than article 1, slightly subfalcate, lined on inner edge with 6 strong spine-setae; gnathopod 1 subchelate, palm nearly transverse, gnathopod 2 subchelate but palm indistinct from the hindmargin of article 6.

Type species: *Liagoceradocus pusillus*, new species.

Relationship: This genus differs from *Anelasmopus* Oliveira (1953) and *Pherusa* Leach (a homonym requiring a new name) by the long rami of uropod 3, of which the outer is biarticulate. It differs

from *Ceradocopsis* Schellenberg (1926) by the indistinct palm of gnathopod 2.

The genus resembles *Ceradocus* Costa closely but differs by the biarticulate outer ramus of uropod 3.

Liagoceradocus pusillus, new species

FIGURE 15

Diagnosis: With the characters of the genus.

Descriptive features: The mouthparts are generally like those of *Ceradocus*, although the third mandibular palp article is subfalcate and somewhat stouter than in most species of *Ceradocus;* the third maxillipedal palp article is produced apically as shown in the figure; eyes apparently are absent; lateral lobes of head broad and poorly

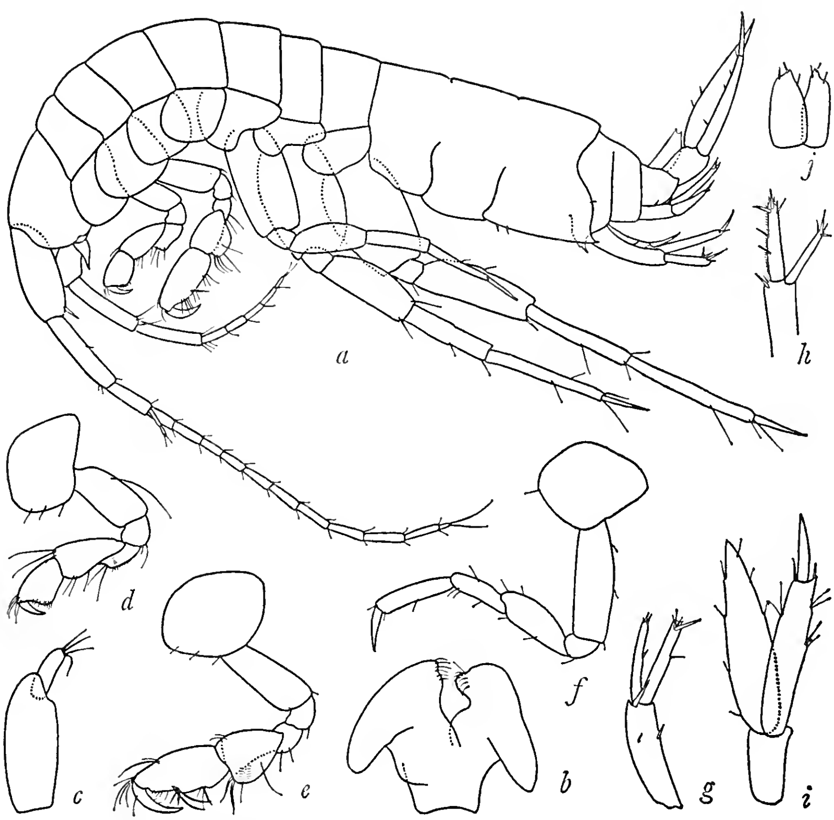

FIGURE 15.—*Liagoceradocus pusillus*, new species, holotype, ?male, 1.5 mm., Abbott sta. 123-D-2: *a*, lateral view, some details of pleon segments obscure; *b*, lower lip; *c*, articles 3–4 of maxillipedal palp; *d, e*, gnathopods 1, 2; *f*, pereopod 1; *g–i*, uropods 1, 2, 3; *j*, telson.

produced; third pleonal epimeron produced into a small tooth at the lower posterior corner.

Holotype: USNM 106884, ?male, 1.5 mm.

Type locality: Abbott station 123–D–2, Ifaluk Atoll, Oct. 18, 1953.

Material: 2 specimens from the type locality.

Distribution: Ifaluk Atoll, Caroline Islands.

Genus *Maera* Leach

This is perhaps the most abundant genus in the collections. Its taxonomy is in a confused state and seriously in need of a revision by a single specialist. The materials at hand are especially difficult to identify because of the lack of large suites of material from a single locality and because most of the specimens are immature. There is little difficulty in identifying *M. insignis* and *M. othonopsis* and the problem lies in those species having second gnathopods with transverse palms. Few of these specimens are mature and apparently the metamorphosis of the palmar configuration into the adult sculpturing passes through several stages in both males and females and all the initial stages are similar. Although the adult palms in *M. inaequipes, M. pacifica,* and *M. quadrimana* differ, they are alike in the juvenile stages.

In order to identify these species, one must examine the telson. Each lobe of the telson in *M. inaequipes* is deeply notched (Schellenberg 1938a, fig. 18) but to observe this character it is necessary to dissect and mount the telson of each individual, a laborious procedure in such small animals. *Maera pacifica* and *M. quadrimana* have blunt telsonic lobes (Schellenberg 1938a, figs. 19, 22) and often can be separated from each other by the stoutness of the second articles on pereopods 3–5 of *M. pacifica* (see Schellenberg 1938a, figs. 19–22). Unfortunately, many of the specimens at hand have lost the pereopods so that positive identification is impossible. When one specimen in a lot can be identified as one or the other species, I have included the remaining damaged specimens in the identification.

All specimens of *Maera quadrimana* in the Reish collections have stout basal articles on the last 3 pairs of pereopods, forming a perplexing exception to Schellenberg's otherwise neat separation of *M. pacifica* and *M. quadrimana.* I have no doubt that these specimens are *M. quadrimana* as seen in the figures of the gnathopods presented here. As there are no clear differences in the young of *M. pacifica,* one must rely on the length of the defining palmar tooth of gnathopod 2 in the young of both sexes, which is long in *M. pacifica* and short in *M. quadrimana.*

Key to the Females and Juveniles of *Maera*

1. Pleonal segment 4 with 2 sharp dorsal carinae . . . . **M. insignis**
   Pleonal segment 4 smooth 2
2. Telson with notched apices 3
   Telson with blunt apices 4
3. Third pleonal epimeron smooth behind . . . . **M. inaequipes**
   Third pleonal epimeron serrate behind . . . . . . **M. inaequipes serratus**
4. Gnathopod 2, palm oblique . . . . **M. othonopsis**
   Gnathopod 2, palm transverse 5
5. Adult males with 3 palmar teeth on gnathopod 2, young males, females and juveniles having smooth palms, with short defining tooth . **M. quadrimana**
   Adult males with one blunt palmer tooth on gnathopod 2, young males, females and juveniles having smooth palms, with long defining tooth . . . . **M. pacifica**

Maera hamigera Haswell

FIGURE 16

Moera [sic] *hamigera* Haswell, 1879b, p. 333, pl. 21, fig. 1; 1882, pp. 254–255.
Megamoera suensis var., Haswell, 1885, p. 103, pl. 15, figs. 1–4.
Maera hamigera.—Stebbing, 1906, p. 437.—Walker, 1909, p. 335.—Stebbing, 1910b, pp. 600–601, 642.—K. H. Barnard, 1916, pp. 196–197, pl. 27, figs. 11–12.—Chilton, 1921, p. 73.

Diagnosis: No segments dorsally dentate; posterior edge of third pleonal epimeron serrate, lower edge smooth; uropod 3 extending much beyond uropods 1 and 2; palm of male gnathopod 2 distinct from hindedge of article 6; apices of telson notched; base of article 7 of male gnathopod 2 strongly curved.

Description: Eyes rather large, subreniform, ommatidia not closely packed; article 6 of one male gnathopod 2 (figure 16*k*) rather slender but very massive, palm nearly transverse but short, defined by a strong tooth bearing a large spine, palm with 2 or 3 teeth; other male second gnathopod (figure 16*j*) (usually the left one) very small, of similar shape but palm lacking defining tooth and bearing several large spines, article 7 not strongly curved at base; gerontic females having gnathopods similar to males (figures 16*a*, *f*); other adult females having both second gnathopods like the small one of gerontic females (figure 16*e*); smaller but still adult females having both second gnathopods small but the palm scarcely distinct from the hindmargin of article 6 (figure 16*m*); finally an aberrant form was found (figure 16*i*) having article 6 of gnathopod 2 stouter, the palm formed into about 7 small even teeth, and the finger swollen near its apex (see K. H. Barnard, 1916).

Thus there are five principal forms of this species in these collections.

Remarks: In light of the variability seen in this species and in my initial difficulty in identifying females of this species until males came to light, it is necessary to explore its relationship to such species

as *Maera mastersi* (Haswell) and *M. othonides* Walker. Complications arise because both species were inadequately described by their erectors. The first redescription of *M. mastersi* by Chilton (1916, lacking figures) caused some confusion to Schellenberg (1938a) for he reported that *M. othonides* and *M. mastersi* differed by the produced first coxa of *M. othonides* as contrasted with the rounded

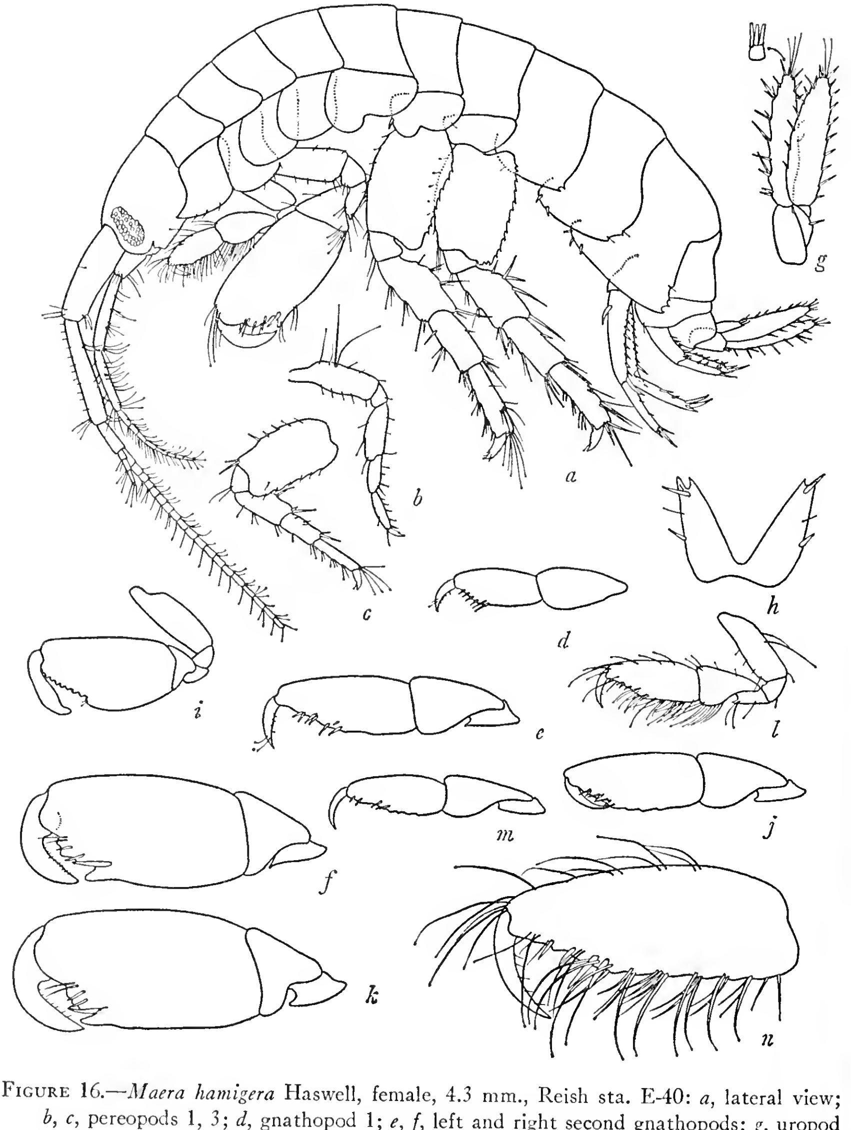

FIGURE 16.—*Maera hamigera* Haswell, female, 4.3 mm., Reish sta. E-40: *a*, lateral view; *b*, *c*, pereopods 1, 3; *d*, gnathopod 1; *e*, *f*, left and right second gnathopods; *g*, uropod 3; *h*, telson; aberrant specimen, 2.5 mm.: *i*, gnathopod 2; male, 5 mm.: *j*, *k*, gnathopods 1, 2; female: *l*, *m*, second gnathopods; female, 6 mm., Reish sta. E–163: *n*, gnathopod 2.

coxa of *M. mastersi* (this statement appears on p. 48 under *M. othonopsis*, new species). Chilton had written in his remarks that the first coxa was like that of *M. bruzelii* Stebbing (1888), which, if closely examined, appears to have the coxa acutely produced forward. Stebbing's (1906) description of *M. mastersi* was undoubtedly based on the poor original figures of Haswell (1879b). Although Sheard (1936) mentioned variability, his redescription of *M. mastersi* seems to fit most of Chilton's (1916) remarks except for the heavier palmar teeth of gnathopod 2. At this stage of the situation one must accept Sheard's figuring of the species as a starting point. In so doing, one is immediately struck with the similarity of that description with the redescription of *Maera othonides* Walker by Pirlot (1936), who relegated it to a new genus *Linguimaera*, since rejected. I am unable to see any qualitative differences between the two redescriptions. Walker (1904) originally figured only the uropods, telson, and third pleonal epimeron. Only in the telson can one find a discrepancy: Sheard described a telson with narrow lobes, evenly notched; Walker described narrow lobes quite asymmetrically notched. Chilton's (1916) description would seem to fit Walker's better than Sheard's, so we are left with the possibility that the telson varies to such extremes.

K. H. Barnard (1916) described but did not figure a specimen of *Maera mastersi* from South Africa in which one male gnathopod had rather strong and acute palmar teeth, especially having a distinct defining tooth; the other gnathopod was smaller, with the palm ill defined and lacking teeth. K. H. Barnard also described South African *Maera hamigera* with figures of two kinds of gnathopods, one of which is similar to the aberrant form herein described. The other gnathopod is in a somewhat intermediate condition between right and left gnathopods of adult males as herein described. I am not certain how he distinguished these specimens from his *M. mastersi*, since this intermediate second gnathopod fits his description of the *M. mastersi* gnathopod to a degree.

The variability seen in the present material makes necessary the suggestion that *Maera mastersi* and *M. othonides*, which themselves are most certainly closely related if not synonymous, may be growth stages of *M. hamigera*. This is vaguely contradicted by the fact that *M. mastersi* has been reported so many times previously but no worker has related it to *M. hamigera*. One may inspect Sheard's and Pirlot's drawings and still see minute differences in the gnathopodal palms between *M. mastersi* and *M. hamigera* and the writer leaves this as the only way to separate the species at present. In J. L. Barnard's (1962b) key to *Maera*, the species have been separated by considering only developed adult males, assuming that *M. mastersi* is such.

Material: Reish stations E–40 (7), E–41 (1), E–42 (5), E–43 (3), E–137 (1), E–163 (2).

Distribution: Australia, South Africa, Red Sea, in shallow waters to depths as great as 85 fathoms; Eniwetok Atoll, Marshall Islands.

Maera inaequipes (Costa)

Maera inaequipes (Costa).—J. L. Barnard, 1959, pp. 25–26, pl. 5 (with references).

Material: Abbott stations 72–G–3 (3), 160–165–J–5 (1); Reish station E–44 (7).

Remarks: These immature specimens have the typically notched telsonic apices and fit the figures of Chevreux and Fage (1925) relatively well. J. L. Barnard (1959) has written extensive comments on this species and its polymorphy; it is still questionable whether his Californian representatives of this species are truly *M. inaequipes* since the telson in that material has blunt apices; if such polymorphy is realistic, it then complicates the identification of the atoll material because the young *M. pacifica* segregated herein would be assigned to *M. inaequipes*. The life histories of these species need study by resident zoologists in the tropics.

Distribution: Cosmopolitan in tropical and warm-temperate.

Maera inaequipes serrata Schellenberg

Maera inaequipes serrata Schellenberg, 1938a, pp. 41–42, fig. 18.

Material: Abbott stations 40–E–3 (1), 42–F–2 (2), 76–H–3 (1), 81–B–4d (2), 113–H–2 (27), 116–F–3 (2), 125–D–3 (2), 126–C–4 (1), 141–D–3 (1), 142–E–4 (1), 144–F–2 (1), 179–184–M–1 (3); Reish stations E–28 (1), E–40 (6), E–42 (1), E–85 (1), E–137 (1), E–166 (1).

Distribution: Gilbert Islands; Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Maera insignis (Chevreux)

Maera insignis (Chevreux).—Schellenberg 1938a, pp. 50–52, fig. 24.—J. L. Barnard. 1955, pp. 12–13.

Material: Abbott stations 22–D–5 (6), 23–E–2 (1), 24–C–1 (4), 26–F–2 (6), 27–F–1 (4), 28–D–3 (2), 29–C–1 (3), 30–C–4 (5), 31–D–2 (10), 32–G–3 (7), 39–E–5 (2), 40–E–3 (16), 41–D–3 (21), 42–F–2 (15), 44–D–3 (3), 46–E–2 (7), 48–E–1 (13), 49–E–2 (10), 50–E–1 (17), 66–E–10 (3), 69–E–7 (1), 83–E–1 (3), 91–E–2 (1), 128–C–5 (1); Bayer stations 431 (9), 589 (1); Reish stations E–75 (1), E–83 (1), E–137 (4), E–138 (1).

Distribution: Indo-Pacific: Seychelles, Chagos, Flores, Philippines, Micronesia, Fiji, Ellice, Hawaii.

Maera othonopsis Schellenberg

Maera othonopsis Schellenberg, 1938a, pp. 48–50, fig. 23.

Material: Abbott station 31–D–2 (1 ovigerous female); Reish station E–43 (1).

Distribution: Gilbert Islands; Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Maera pacifica Schellenberg

Maera pacifica Schellenberg, 1938a, pp. 42–45, figs. 19, 20.

Material: Abbott stations 49–E–2 (4), 83–E–1 (7), 84–D–1 (2), 85–F–3 (1), 91–E–2 (10), 95–O–4 (1), 112–I–5 (1); Bayer station 431 (1); Reish station E–53 (9).

Remarks: None of the present specimens is sufficiently mature to reflect any of the taxonomic characteristics described or figured by Schellenberg. The materials have been identified by a process of elimination, since the structure of the telson and third uropods are not those of *M. inaequipes* or *M. quadrimana.* The third uropods bear short rami.

Distribution: Gilbert, Fiji, Hawaiian Islands; Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Maera quadrimana (Dana)

FIGURE 17

Maera quadrimana (Dana).—Schellenberg, 1938a, pp. 45–48, figs. 21–22.—J. L. Barnard, 1955, p. 13.

Material: Abbott station 141–D–3 (1); Reish stations E–75 (1), E–77 (5), E–85 (9), E–88 (17).

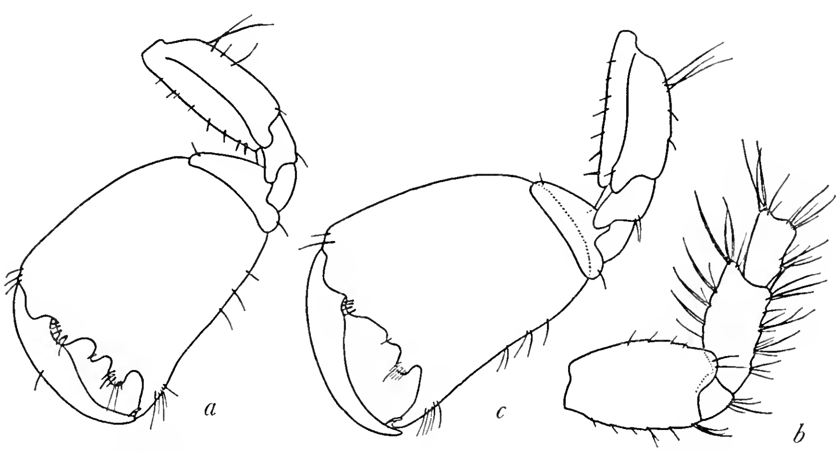

FIGURE 17.—*Maera quadrimana* (Dana), female, 4.5 mm., Reish sta. E-85: *a*, gnathopod 2; *b*, pereopod 5; male, 5 mm., Reish sta. E-85: *c*, gnathopod 2.

Remarks: The juvenile specimen of 141–D–3 is referred to this species on the basis of the slender second articles of pereopods 3–5 on which the lower corners are quadrate (Schellenberg 1938a, figure 21g). Schellenberg adequately separated females and young of *M. quadrimana* and *M. pacifica*, which in adult males have different palmar sculpturing on the second gnathopods, by the narrow basal articles of pereopods 3–5 in *M. quadrimana* and the broad ones in *M. pacifica*. Dana's (1853) material had narrow basal articles; Schellenberg found several specimens of this kind and I have found one; however, the Reish specimens of *M. quadrimana* cited above have broad basal articles of those pereopods as figured herein; yet the specimens are unconfuted *M. quadrimana* because of their gnathopodal configurations. Schellenberg also found specimens of *M. quadrimana* with slightly broadened basal articles, suggesting that this species has several phenotypes respective to this character. *Maera pacifica* Schellenberg (1938a) may be simply another phenotype of *M. quadrimana* based on second gnathopods rather than on pereopods 3–5.

Distribution: Gilbert, Fiji, Hawaiian Islands; Ifaluk Atoll, Caroline Islands, Eniwetok Atoll, Marshall Islands.

Genus *Parelasmopus* Stebbing

Parelasmopus albidus (Dana)

Parelasmopus albidus (Dana).—Schellenberg, 1938a, pp. 61–62, fig. 32.

Material: Abbott station 141–D–3 (1 young).

Distribution: Gilbert Islands; Samoa; Ifaluk Atoll, Caroline Islands.

Parelasmopus resacus, new species

FIGURE 18

Diagnosis of male: No segment dorsally dentate or carinate; lateral lobes of head very broad, eyes large; accessory flagellum composed of one long article tipped with a smaller one; apex of maxillipedal palp article 3 tipped with a small granular bump; article 1 of mandibular palp scarcely longer than article 2, article 3 no longer than 2; palm of gnathopod 2 oblique, bearing a small tooth near hinge, a large medial process and a defining tooth, article 7 not reaching end of palm; coxae 1 and 2 each with a ventral serration; third pleonal epimeron with a tooth at lower hindcorner but not serrate on either hind- or ventral edges; telson short.

Female: Gnathopod 2 quite small.

Holotype: USNM 106878 male, 4 mm.

Type locality: Abbott station 145–C–3, Ifaluk Atoll, Oct. 21, 1953.

Material: Abbott stations 81–B–4d (17), 102–B–2 (6), 145–C–3 (2), 152–D–3 (2).

Relationship: This species differs from the other two of the genus, *P. suluensis* (Dana) and *P. albidus* (Dana) by the lack of dorsal segmental teeth. The mandibular palp is barely distinct from that of the genus *Maera* but article 1 is definitely elongated so that this species, therefore, is relegated to *Parelasmopus*.

Distribution: Ifaluk Atoll, Caroline Islands.

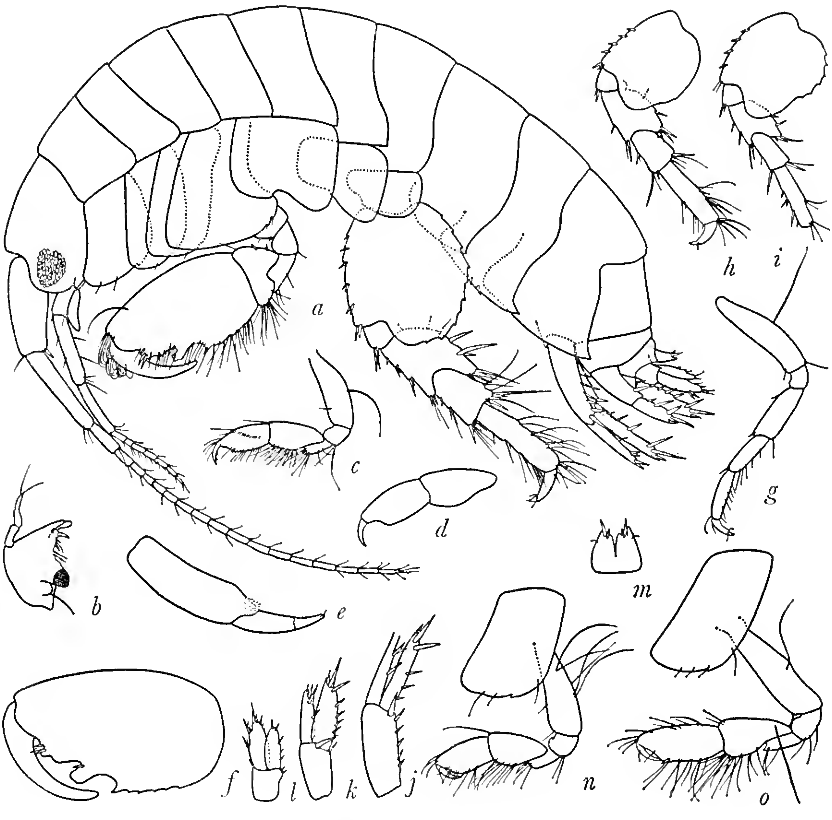

FIGURE 18.—*Parelasmopus resacus*, new species, holotype, male, 4 mm., Abbott sta. 145-C-3: *a*, lateral view; *b*, mandible; *c,d*, gnathopod 1; *e*, end of maxillipedal palp; *f*, end of gnathopod 2; *g–i*, pereopods 1, 3, 4; *j–l*, uropods 1, 2, 3; *m*, telson; female, 3.3 mm.: *n,o*, gnathopods 1, 2.

Beaudettiidae, new family

Diagnosis: Antenna 1 with small accessory flagellum; mandible lacking palp, with well developed triturating molar; upper lip truncate below; lower lip with inner lobes and acutely pointed mandibular processes; maxilla 1 with slender inner plate bearing a few terminal setae, palp biarticulate; maxilla 2 composed of 2 slender lobes, apically

setose only; maxilliped with inner and outer plates well developed, palp composed of four articles; gnathopod 2 larger than 1, article 3 of gnathopod 2 short; telson not distinctly split, slightly emarginate; uropod 3 with 2 rami; the inner one, half as long as the outer; all segments of urosome separate.

Type genus: *Beaudettia*, new genus.

Relationship: This unusual, although plain amphipod, combines the characteristics of several families. Superficially it appears to be in the Gammaridae or Photidae but has other characteristics of the superfamily Talitroidea (incl. Hyalidae).

The lack of a mandibular palp removes the genus from the Gammaridae and Photidae, but the presence of an accessory flagellum and inner lobes of the lower lip restrict it from the Talitroidea.

The antennae are those of the Gammaridae; the lateral head lobe and its notch are those of Gammaridae; the mandible is that of Talitroidea; the lower lip is that of the Photidae and Aoridae; both pairs of maxillae differ from those of any of the three mentioned families by the slender lobes; the maxilliped is not unique; the gnathopods could be those of either Gammaridae or Photidae but inconceivably of Talitroidea; the telson is rather unique, not fitting any of the mentioned families, but certainly closer to Photidae than the others; the third uropod is peculiar, like that of some Photidae but it could be one of the Gammaridae highly modified; the segregation of urosomal segments among numerous other criteria separates the family from the Dexaminidae.

If the species had a mandibular palp, I would place the genus in the Photidae but this would obscure its special characters such as the head lobe notch and the very slender maxillae, which resemble Gammaridae more than Photidae.

Beaudettia, new genus

Diagnosis: With the characters of the family.

Type species: *Beaudettia palmeri*, new species.

Beaudettia palmeri, new species

FIGURES 19, 20

Diagnosis: With the characters of the family.

Description: Article 2 of antenna 1 as long as article 1, article 3 two-thirds as long as article 2, accessory flagellum stout, short, composed of a long article tipped with a short one; antenna 1 much longer than antenna 2, the antennae otherwise resembling the genus *Elasmopus;* gnathopods rather like those of the genus *Elasmopus*, the palm of the second in the male undefined from the hindmargin of article 6, bearing a stout process toward the finger hinge, finger

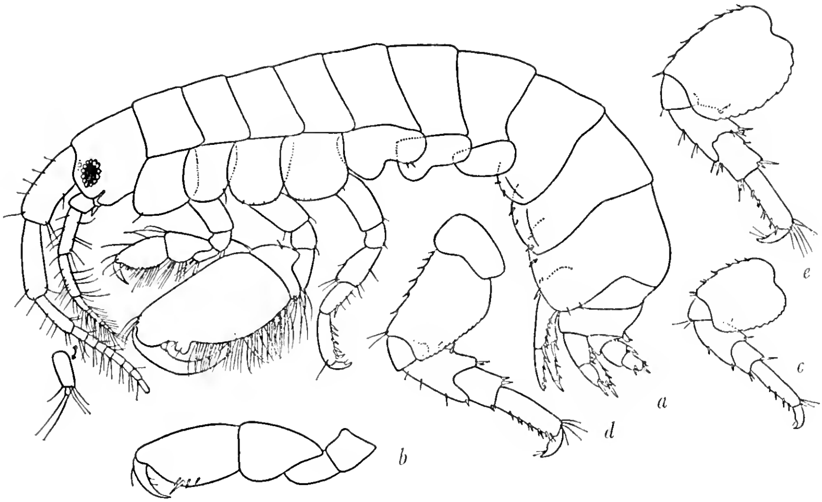

FIGURE 19.—*Beaudettia palmeri*, new species, holotype, male, 3.3 mm., Reish sta. E–20: *a*, lateral view with enlarged accessory flagellum shown; *b*, gnathopod 1; *c–e*, pereopods 3, 4, 5.

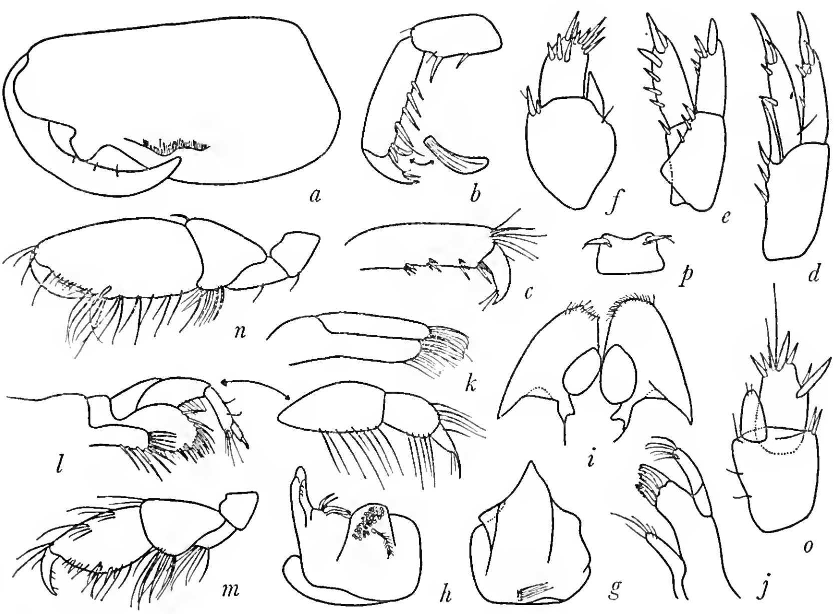

FIGURE 20.—*Beaudettia palmeri*, new species, holotype, male, 3.3 mm., Reish sta. E–20: *a*, gnathopod 2; *b,c*, ends of pereopods 1, 5; *d–f*, uropods 1, 2, 3; female, 2.5 mm.: *g*, upper lip; *h*, mandible; *i*, lower lip; *j,k*, maxillae 1, 2; *l*, maxilliped; *m,n*, gnathopods 1, 2; *o*, uropod 3; *p*, telson.

half as long as article 6, curved, with a small inner bump near base, hindedge of article 6 and palm fringed with long setae; coxa 4 only slightly concave on its hind edge; pereopods 1 and 2 with one or two large striated distal spines on article 6, like some species of *Hyale.*

Holotype: USNM 107572, male, 3.3 mm.

Type locality: Reish station E–120, Eniwetok Atoll, Sept. 7, 1956.

Material: 3 specimens from the type locality.

Remarks: In many respects this species resembles *Elasmopus ecuadorensis* or *E. pectenicrus,* from precursors of which this species might have evolved by loss of the mandibular palp, reduction of the inner ramus of uropod 3, shortening of the telson and the fusion of its lobes. This degeneration of morphological characters of an animal obviously stemming from the Gammaridae is most remarkable.

Distribution: Eniwetok Atoll, Marshall Islands.

Family Hyalidae

The genus *Parallorchestes* Shoemaker (1941) is not a synonym of *Parhyale,* as followed by Bulycheva (1957); in fact, according to her partitioning of the Talitridae into three families, Talitridae, Hyalidae, and Hyalellidae, the genus *Parallorchestes* by its possession of a biarticulate first maxillary palp should be removed from the genus *Parhyale* in the Hyalidae to the Talitridae proper. There it differs from the four known genera *Talitrus, Talorchestia, Orchestia,* and *Orchestoidea* by its biramous third uropod, the inner ramus being very small. The genus *Neobule,* poorly described and unrecovered since its description by Haswell (1879a) is not assignable, as yet, to any family.

Bulycheva's redescription of *Parhyale zibillina* contradicts Shoemaker's (1956) note that the species might belong to *Parallorchestes;* with its simple first maxillary palp it belongs with *Parhyale* in the family Hyalidae.

Genus *Hyale* Rathke

With 43 valid species and 15 dubious species, this genus poses problems of identification because of its simplified morphology and the lack of ornamentation.

Principal features of specific morphological variation lie in the lengths of the antennae, the stoutness of antenna 2, the shapes of the gnathopods, and the presence or absence of stout striated spines on the sixth articles of pereopods 1–5.

Defects in classification lie in the poor knowledge of growth stages particularly in species such as *H. macrodactyla* and *H. chevreuxi* where the adult male second gnathopods have palms confluent with the hindmargins of article 6 and possibly develop this condition from

younger stages having distinct oblique palms (see Schellenberg 1939). Another problem is whether the shapes of the first two coxae always have been determined properly, for some species have coxae with slight posterior lobes or processes and others do not. These would be useful characters if they can be verified in each species.

The following key to *Hyale* is simply a survey of the literature and suffers the defects of such compilation without access to materials of each species. Following it are notes concerning additional changes since J. L. Barnard's Index (1958).

Key to Male *Hyale*

1. Eyes absent, ramus of uropod 3 short, antennae subequal, pereopod 5 very elongated 2
   Eyes present, other characters not in this combination 3
2. Gnathopod 2 of female like that of male, large and well developed. **H. jeanelli**
   Gnathopod 2 of female, with short and distally broadened sixth article. **H. incerta**
3. Body dorsally carinate . . . . **H. carinata**
   Body not dorsally carinate 4
4. Antenna 2 longer than body . . . . **H. campbellica**
   Antenna 2 shorter than body 5
5. Finger of gnathopod 1 strongly furcate . . . . **H. diplodactyla**
   Finger of gnathopod 1 not furcate 6
6. Article 6 of gnathopod 1 with anterior hump . . . . **H. galateae**
   Article 6 of gnathopod 1 smooth on anterior margin 7
7. Dactylus of pereopods 1–5 with very large accessory seta near inner base . 8
   Dactylus of pereopods 1–5 with medium-sized to small seta near middle or absent 10
8. Palm of gnathopod 2 distinct from hindmargin of article 6 9
   Palm of gnathopod 2 not distinct from hindmargin of article 6. **H. ramalhoi**
9. Coxa 1 bearing a hindlobe . . . . **H. spinidactyla**
   Coxa 1 lacking a hindlobe . . . . **H. spinidactyloides**
10. Article 6 of pereopods 1–5 with a long stout striated distal spine on inner margin, the spine larger than neighboring spines 11
    Article 6 of pereopods 1–5 with short or slender, usually unstriated distal spine on inner margin, not larger than other spines 21
11. Palm of gnathopod 1 transverse 12
    Palm of gnathopod 1 oblique 13
12. Hindmargin of article 6 on gnathopod 2 longer than palm . . . **H. pontica**
    Hindmargin of article 6 on gnathopod 2 scarcely existent, palm nearly contiguous with it . . . . **H. maroubrae**
13. Article 6 of gnathopod 2 with large hindtooth . . . . **H. dentifera**
    Article 6 of gnathopod 2 lacking large hindtooth 14
14 Palm of gnathopod 2 distinct from hindmargin of article 6 15
    Palm of gnathopod 2 continuous with hindmargin of article 6 19
15. Palm of gnathopod 1 broadly expanded, defined by a large bump. **H. affinis**
    Palm of gnathopod 1 scarcely expanded, not defined by a large bump . . 16

16. Hindmargin of article 6 on gnathopod 2 quite short, palm with two bumps. **H. pusilla**
    Hindmargin of article 6 on gnathopod 2 almost as long as palm, palm lacking distinct bumps 17
17. Palm of gnathopod 1 40% as long as hindmargin of article 6 . **H. pygmaea**
    Palm of gnathopod 1 more than 70% as long as hindmargin of article 6 . 18
18. Palm of gnathopod 2 not defined by spines . . . . **H. media**
    Palm of gnathopod 2 defined by 2 spines . . . . . **H. saldanha** (in part)
19. Palm of gnathopod 2 with one or more bumps 20
    Palm of gnathopod 2 lacking bumps . . . . **H. honoluluensis**
20. Palmar bump of gnathopod 2 one-third of the palmar distance from finger hinge . . . . **H. macrodactyla**
    Palmar bump of gnathopod 2 at finger hinge . . . . **H. chevreuxi**
21. Gnathopod 2 with cuplike hollow lined with setae on medial surface of palm. **H. grenfelli**
    Gnathopod 2 lacking cuplike hollow 22
22. Finger of gnathopod 2 apically inflated . . . . **H. diastoma**
    Finger of gnathopod 2 tapering distally 23
23. Hindmargin of article 6 on gnathopod 2 extremely short or heavily setose. **H. hirtipalma**
    Hindmargin of article 6 on gnathopod 2 not short or not heavily setose . . 24
24. Article 6 of pereopods 4–5 with spines or setae on hindmargin 25
    Article 6 of pereopods 4–5 smooth behind 26
25. Coxa 2 rounded behind . . . . **H. prevosti**
    Coxa 2 with hindlobe . . . . (see notes) **H. iwasai**
26. Antenna 2 "short" (use both halves of couplet) 27
    Antenna 2 "long" 30
27. Finger of pereopods 1–5 pectinate . . . . **H. grandicornis**
    Finger of pereopods 1–5 not pectinate 28
28. Antenna 2 very slender, gnathopod 2 with palmar process near finger hinge. **H. grimaldi**
    Antenna 2 stout, gnathopod 2 lacking palmar processes 29
29. Antenna 2 lacking dense setal tufts . . . **H. crassicornis** and **H. bishopae**
    Antenna 2 with dense setal tufts . . . . **H. plumulosa**
30. Distal finger setule large on pereopods 1–5 . . . . **H. perieri**
    Distal finger setules weak or absent on pereopods 1–5 31
31. Finger of maxilliped with long apical seta or setae. **H. camptonyx** and **H. rubra**
    Finger of maxilliped with short or no apical setae 32
32. Palm of gnathopod 2 defined by 2 large spines . . . **H. saldanha** (in part)
    Palm of gnathopod 2 defined by 1 small or no spine 33
33. Hand of gnathopod 1 expanding distally, broad 34
    Hand of gnathopod 1 rectangular, not expanding distally . . . . **H. nigra**
34. Palm of gnathopod 1 defined by spine and large bump . . . . **H. dollfusi**
    Palm of gnathopod 1 not defined by spine and bump . . . . **H. schmidti**

NOTES.—Bulycheva (1957) refers *Hyale carinata* to *H. pontica* but the female gnathopods of *H. carinata* as figured by Chevreux and Fage (1925) differ from those figured for *H. pontica* both by Sars (1895) and Chevreux and Fage (1925).

Hyale antares Oliveira (1953): only the female is known; it belongs to the group of Hyales having a large, striated distal spine on article 6 of pereopods 1–5.

Hyale bassaringi Derjavin→*Hyale novaezealandiae*→*Hyale grandicornis* by Bulycheva (1957) and Hurley (1957).

Hyale wolffi Reid (1951) is related to *H. media* and *H. pygmaea* but the condition of coxae 1 and 2 is unknown.

Hyale pugettensis (Dana): not well enough described for inclusion.

Hyale iwasai Shoemaker (1956) (=*H. gracilis* Iwasa 1939) probably is a synonym of *Parhyale hawaiensis.* See that species herein and in Shoemaker (1956) for notes.

Hyale saldanha Chilton (1912, see K. H. Barnard 1916) requires two places in the key because it has a short but heavily serrated spine on pereopods 1 and 2, according to K. H. Barnard.

Hyale graminea (Dana): unclear, close to *H. honoluluensis, H. macrodactyla, H. chevreuxi,* and *H. hirtipalma.*

Hyale goetschi Schellenberg, possibly a female.

Hyale changi Chen, reference not available.

Hyale frequens (Stout)→*H. nigra* by J. L. Barnard 1962e.

Hyale chevreuxi K. H. Barnard

FIGURE 21

Hyale macrodactylus Chevreux, 1901, pp. 397–399, figs. 13–14 (not *H. macrodactylus* Stebbing, 1899).—Walker, 1909, p. 337.
Hyale chevreuxi K. H. Barnard, 1916, p. 235 (new name).
Hyale chevreuxi.—Schellenberg, 1938a, pp. 68–69, fig. 35a.

Material: Reish stations E–74 (11), BE–102 (8).

Remarks: None of these specimens quite matches that figured by Chevreux (1901) because the male palms of gnathopod 2 are some-

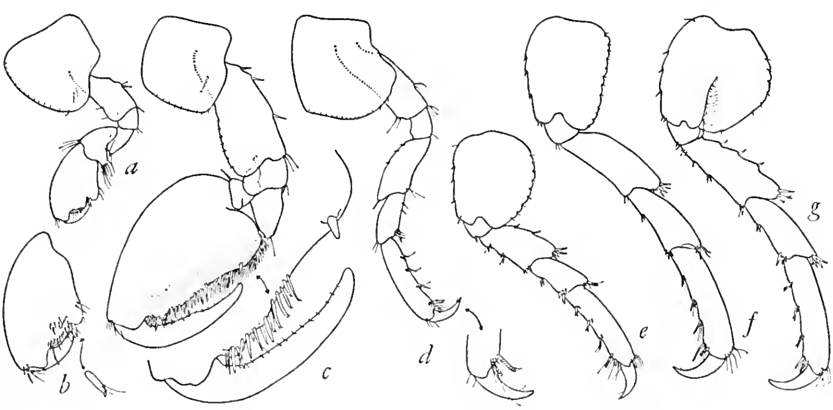

FIGURE 21.—*Hyale chevreuxi* K. H. Barnard, male, 4.2 mm., Reish sta. E–102: *a,b*, gnathopod 1; *c*, gnathopod 2; *d–g*, pereopods 2–5.

what shorter and marked by a large articulated spine and the finger is much shorter. Probably these males are one instar younger than the adult figured by Chevreux, but the life history should be studied to confirm this. Because an apparent young male has a second gnathopod rather like that of any young *Hyale*, such as *H. media*, identification of juvenile males may be impossible.

Distribution: Seychelles and Chagos Archipelagos; Gilbert Islands; Eniwetok Atoll, Bikini Atoll, Marshall Islands.

Hyale dentifera Chevreux

Hyale dentifera Chevreux, 1907, pp. 414–415; 1908, pp. 499–503, figs. 18–20.

Material: Reish stations E–72 (5), E–73 (2), BE–101 (1).

Distribution: Gambier Archipelago; Eniwetok and Bikini Atolls, Marshall Islands.

Hyale honoluluensis Schellenberg

FIGURES 22, 23

Hyale honoluluensis Schellenberg, 1938a, pp. 69–71, figs. 35b,c.—J. L. Barnard, 1955, p. 18.

Material: Reish stations E–21 (1), E–38 (5), E–50 (4), E–68 (16), E–93 (10), BE–101 (10), E–116 (8), E–118 (9), E–140 (7), E–171 (4).

Remarks: The spines on the palm of the second gnathopod are much stouter than figured by Schellenberg and the palm of the first gnathopod is defined by a large spine.

Distribution: Hawaiian Islands; Eniwetok Atoll, Marshall Islands.

Hyale media (Dana)

Hyale media (Dana).—Stebbing, 1906, pp. 569–570.—Shoemaker, 1935, pp. 243–244.—Schellenberg, 1939, pp. 128–129.—Stephensen 1949, pp. 37–41, figs. 16–17.—Ruffo, 1950, pp. 60–62, figs. 4 (5–10), 5.—Oliveira, 1953, 344, pl. 17.—Ruffo, 1956, pp. 213–215.—Hurley, 1957, pp. 916–919, figs. 72–90.
Hyale ayeli J. L. Barnard, 1955, pp. 14–15, fig. 7.

Material: Reish stations E–73 (4), E–77 (4), E–94 (8), BE–101 (22).

Remarks: Apparently *Hyale ayeli* is an excessively setose form of this species. When described, it was compared with figures of *H. media* published by Stephensen (1949) wherein no setae are present on the hindmargin of article 5 of antenna 2; since then, Ruffo (1956) has called attention to the resemblance of *H. ayeli* to a form of *H. media* figured by him (Ruffo, 1950) from Venezuela having a moderate number of posterior setae; Hurley (1957) also shows small posterior bundles of setae.

The specimens identified herein have virtually no setae on the antennal peduncles. Most of the specimens are smaller than 3.8 mm.

in length. In Reish station E–101, the only male larger than that size (with a length of 4.5 mm.) has gnathopod 1 with the distal part of article 6 somewhat widened, approaching *Hyale affinis* Chevreux (1908). Possibly *Hyale affinis* is the terminal adult of *H. media* but the present materials show only this one case and others should be discovered before a decision can be made.

Distribution: Pantropical; recorded here from Eniwetok and Bikini Atolls, Marshall Islands.

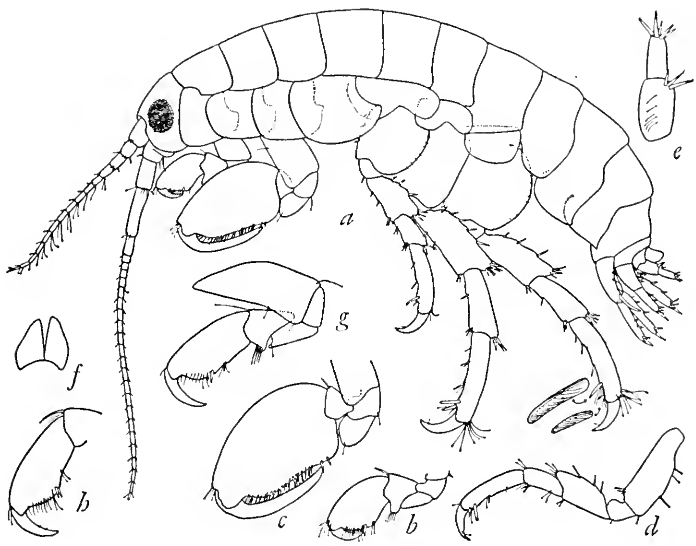

FIGURE 22.—*Hyale honoluluensis* Schellenberg, male, 4.8 mm., Reish sta. E–101: *a*, lateral view; *b,c*, gnathopods 1, 2; *d*, pereopod 1; *e*, uropod 3; *f*, telson; female, 4 mm., *g,h*, gnathopods 1, 2.

Genus *Parhyale* Stebbing

Parhyale hawaiensis (Dana)

FIGURE 24

Parhyale hawaiensis (Dana).—Shoemaker, 1956, pp. 351–357, figs. 3, 4 (with references).—Ruffo 1959, pp. 17–18.
Parhyale inyacka (K. H. Barnard).—J. L. Barnard, 1955, p. 23, fig. 12.

Material: Abbott stations 51–C–2 (4), 53–B–3 (3), 55–C–3 (5), 83–E–1 (1), 91–E–2 (11), 197–198–F–1 (25); Hand station CH–609 (6); Bayer station 800 (1); Reish station ME–62 (4).

Remarks: All specimens except those from the Reish station typically possess a distinctly articulated inner ramus of uropod 3 as figured by Shoemaker (1956); however, the 4 Reish specimens have simply a small, scarcely perceptible, firmly fused process, with no lines of demarcation representing the inner ramus of uropod 3.

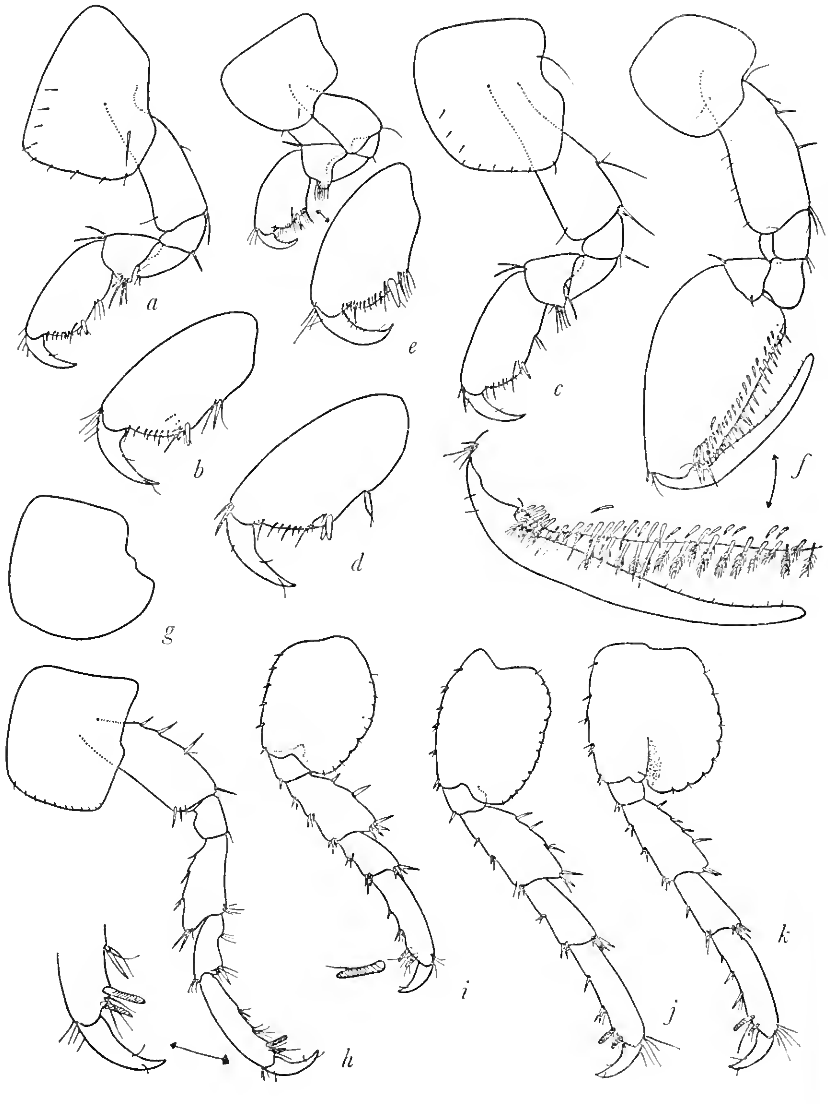

FIGURE 23.—*Hyale honoluluensis* Schellenberg, female, 3 mm., Reish sta. E–68: *a,b,* gnathopod 1; *c,d,* gnathopod 2; male, 4.2 mm., Reish E–118: *e,f,* gnathopods 1, 2; *g,* coxa 4; *h–k,* pereopods 1, 3, 4, 5.

Technically the specimens should be placed in the genus *Hyale* but all other features are definitely those of *P. hawaiensis*, including female second gnathopods with a process on article 2. The only species in *Hyale* to which these specimens might be keyed is *H. iwasai* (=*H. gracilis Iwasa* 1939), which Shoemaker (1956) has suggested might be *P. hawaiensis*. I concur with Shoemaker's suggestion. The

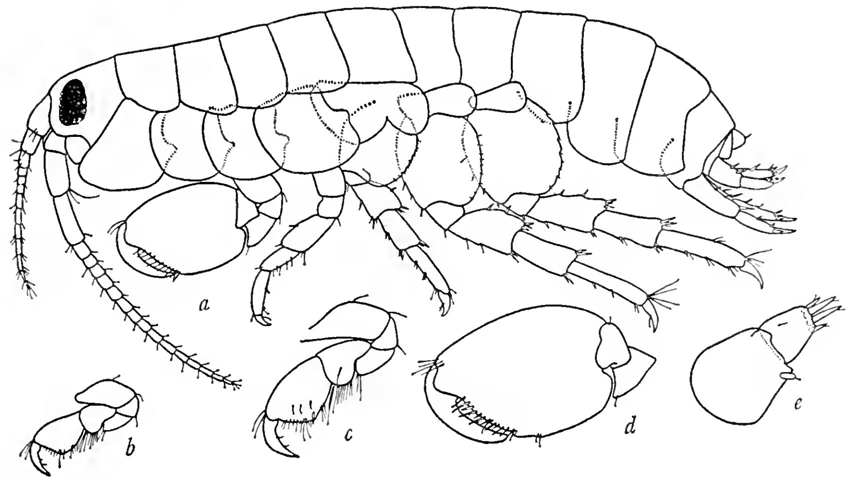

FIGURE 24.—*Parhyale hawaiensis* (Dana), male, 4 mm., Reish sta. E-62: *a*, lateral view, less uropod 3; *b,c*, gnathopod 1; *d*, gnathopod 2; *e*, uropod 3.

only difference in the two forms is the presence of a lateral spine on the ramus of uropod 3 in *H. iwasai* and a more slender uropod 3; the distal process of article 2 of the female gnathopod 2 also is poorly developed.

It is necessary to keep in mind that some specimens of *P. hawaiensis* have a fused inner ramus of uropod 3 and they must be detected in other ways. Shoemaker's analysis of the species is exemplary and should be used as the model for comparison.

Distribution: Pantropical and warm-temperate.

Family Dexaminidae

Genus *Dexaminoides* Spandl

Dexaminoides orientalis Spandl

FIGURE 25

Dexaminoides orientalis Spandl, 1924, pp. 56–59, figs. 21, 22.—Schellenberg, 1928, pp. 653–655, fig. 202.

Material: Abbott stations 124–D–3 (1), 125–D–3 (3).

Remarks: Schellenberg (1928) has corrected several errors originally made by Spandl and has described the mouthparts.

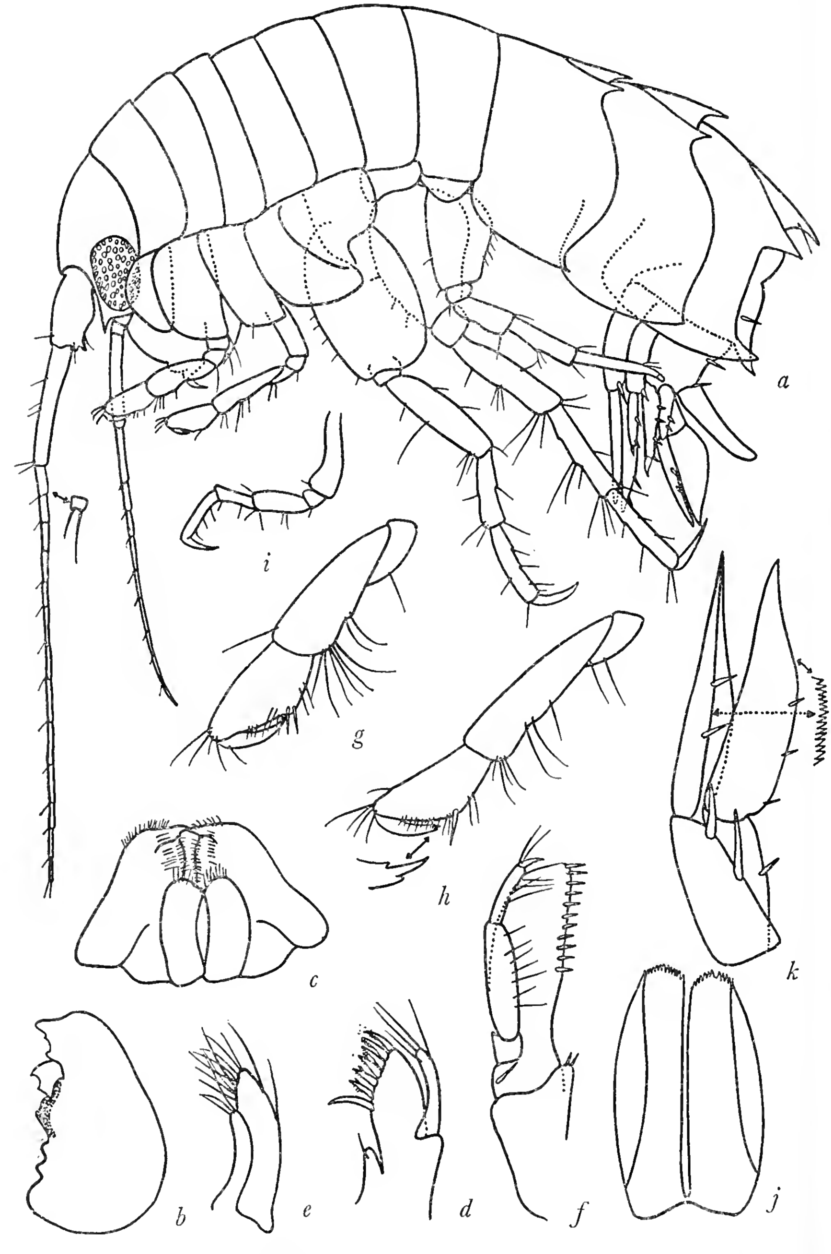

FIGURE 25.—*Dexaminoides orientalis* Spandl, female, 2 mm., Abbott sta. 125–D–3: *a*, lateral view; *b*, mandible; *c*, lower lip; *d,e*, maxillae 1, 2; *f*, maxilliped; *g,h*, ends of gnathopods 1, 2; *i*, pereopod 1; *j*, telson; juvenile, 1.6 mm.: *k*, uropod 3.

The species is figured again herein to give all the mouthparts in perspective and to add a figure of the third uropod.

The specimens at hand differ from the original description in one important point, possibly of subspecific value: the greatly produced tooth on the lower corner of the third pleonal epimeron. I hesitate to erect a new species on this basis because dexaminids are known to vary greatly (witness *Polycheria antarctica*) and the original description may have been in error, although Schellenberg (1928) makes no mention of it.

Distribution: Red Sea; Ifaluk Atoll, Caroline Islands.

Family Aoridae

Genus *Lembos* Bate

Key to the Males

1. Posterodistal end of article 2 on gnathopod 1 with a brush of setae (6 or more setae) 2
   Posterodistal end of article 2 on gnathopod 1 lacking a brush of setae . . 5
2. Pereopod 2 with a strongly setose fourth article . . . . . . **L. hirsutipes**
   Pereopod 2 with a poorly setose fourth article 3
3. Pereopod 1 with a strongly setose fourth article . . . . . **L. megacheir**
   Neither pereopods 1–2 with strongly setose fourth articles 4
4. Palm of gnathopod 1 oblique and bearing a sharp medial tooth . **L. longipes**
   Palm of gnathopod 1 transverse, slightly chelate, lacking medial process. **L. arcticus**
5. Coxa 1 distinctly rounded at anteroventral corner 6
   Coxa 1 pointed at anteroventral corner 14
6. Article 6 of gnathopod 1 essentially bifid, forming a large tooth on posterior edge . . . . **L. jassopsis**
   Article 6 of gnathopod 1 not bifid in this manner 7
7. Article 4 of gnathopod 2 with acute hindprocess 8
   Article 4 of gnathopod 2 lacking acute hindprocess 9
8. Article 2 of gnathopod 2 inflated, article 3 with sharp anterior process. **L. bryopsis**, new species
   Article 2 of gnathopod 2 slender, article 3 not produced . . . **L. hastatus**
9. Article 5 of gnathopod 1 less than one third as long as article 6 10
   Article 5 of gnathopod 1 more than half as long as article 6 11
10. Palm of gnathopod 1 transverse, slightly chelate, article 6 slender. **L. chelatus**
    Palm of gnathopod 1 oblique, defining tooth not reaching a transverse line from hinge, article 6 stout . . . . **L. processifer**
11. Palm of gnathopod 1 strongly excavate, with large defining tooth. **L. philacanthus**
    Palm of gnathopod 1 not excavate, defining tooth small or absent . . . 12
12. Gnathopod 1, anterior and posterior edges of article 6 nearly parallel. **L. tetracanthus**
    Gnathopod 1, article 6 inflated, anterior and posterior edges biconvex . . 13
13. Palm of gnathopod 2 long, article 7 about as long as hindmargin of article 6. **L. francanni**

Palm of gnathopod 2 short, article 7 about half as long as hindmargin of article 6 . . . . **L. smithi**

14. Article 6 of gnathopod 1 essentially bifid, with large proximal posterior tooth . . . . **L. podoceroides**
Article 6 of gnathopod 1 not bifid 15

15. Article 2 of gnathopod 2 strongly inflated . . . . **L. kergueleni**
Article 2 of gnathopod 2 slender, edges subparallel 16

16. Article 6 of gnathopod 2 slightly chelate and longer than article 5. **L. gambiense**
Article 6 of gnathopod 2 not chelate 17

17. Anterior edge of article 5 of gnathopod 1 densely setose . . . **L. websteri**
Anterior edge of article 5 of gnathopod 1 poorly or not setose 18

18. Distal anterior corner of article 2 on gnathopod 2 with process 19
Distal anterior corner of article 2 on gnathopod 2 lacking process 20

19. Defining tooth of gnathopod 1 not set apart from palm . . **L. hypacanthus**
Defining tooth of gnathopod 1 set apart from palm by excavation. **L. concavus**

20. Palm of gnathopod 1 distinctly transverse (see notes) 21
Palm of gnathopod 1 oblique 22

21. Article 7 of gnathopod 1 with inner bump, ventrum of pereon with 4 large and 2 small posteriorly projecting teeth . . . . **L. audbettius**
Article 7 of gnathopod 1 lacking inner bump, ventrum of pereon with 2 anteriorly projecting teeth . . . . **L. macromanus**

22. Eyes absent, coxae very small 23
Eyes present, coxae of normal size 24

23. Pereopod 4 reaching to end of article 4 on pereopod 5 . . . . . **L. lobata**
Pereopod 4 reaching to end of article 5 on pereopod 5 . . **L. longidigitans**

24. Gnathopod 2 quite slender, article 6 nearly twice as long as article 5. **L. leptocheirus**
Gnathopod 2 not markedly slender, article 6 subequal to article 5 in length. 25

25. Palm of gnathopod 1 lacking medial process or one near finger hinge, palm excavate and with defining tooth 26
Palm of gnathopod 1 bearing either a medial process or one near finger hinge. 27

26. Ventrum of pereon garnished with numerous spines . . . . **L. spiniventris**
Ventrum of pereon lacking spines . . . . **L. viguieri**

27. Article 7 of gnathopod 1 overlapping palm by almost half its length. **L. aequimanus**
Article 7 of gnathopod 1 scarcely overlapping palm 28

28. Medial palmar process of gnathopod 1 formed into a distinct blunt lobe. **L. fuegiensis**
Medial palmar process of gnathopod 1 indistinct but sharp . **L. intermedius**

NOTES.—References to species may be consulted in J. L. Barnard's (1958) Index. Other species described since then: *L. audbettius* J. L. Barnard (1962a); *L. lobata* J. L. Barnard (1962d).

Lembos tetracanthus might be the young of *L. francanni*.

L. teleporus K. H. Barnard, 1955: coxa 1 and article 4 of gnathopod 2 not described; keys out either to couplets 7, 9, or 25 but is distinguished from those relatives by gnathopod 1 for which the original drawing should be checked.

Couplet 20: "transverse" indicates an imaginary line from the hinge perpendicular to the long axis of article 6, measured from the middle of the proximal joint to the middle of the palm.

Lembos aequimanus Schellenberg

Figure 26

Lembos (Bemlos) aequimanus Schellenberg, 1938a, pp. 76–77, fig. 39.

Material: Reish stations E–40 (1), E–49 (1), BE–104 (1).

Remarks: Specimens from the last two stations seem to fit this species although they are in poor condition. The female from station E–40 was found associated with the male of the new species *L. bryopsis* (p. 528) and it is debatable whether it is the female of that species or belongs with *L. aequimanus*. If indeed it is the female of *L. bryopsis*, then the females of both *L. bryopsis* and *L. aequimanus* seem identical; on the other hand, this female lacks any of the distinctive characters of *L. bryopsis*. It is scarcely conceivable that Schellenberg's male of *L. aequimanus* was indeed the juvenile of *L. bryopsis* since so many differences are apparent.

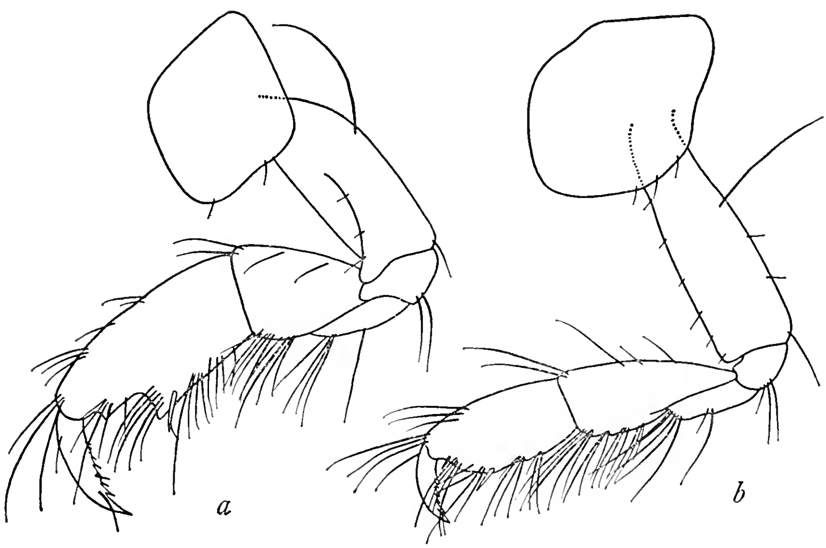

Figure 26.—*Lembos aequimanus* Schellenberg, female, 3.8 mm., Reish sta. E–40: *a,b*, gnathopods 1, 2.

Separation of young animals of *L. intermedius* and *L. aequimanus* should be difficult, for *L. aequimanus* probably represents a stage in the development of *L. intermedius*. In the females at hand the differences between *L. intermedius and L. aequimanus* are as evident as they are between *L. processifer* and *L. aequimanus*, if one recalls that

L. processifer and *L. intermedius* differ only by the first coxa. Thus, some of the specimens identified as young male *L. processifer* may indeed be *L. aequimanus*, although the first coxae should be different.

Distribution: Fiji and Gilbert Islands; Eniwetok and Bikini Atolls, Marshall Islands.

Lembos bryopsis, new species

Figure 27

Diagnosis of male: Eyes rather small, removed from the edges of the lateral lobes; coxa 1 rounded at anterior lower corner; gnathopod 1 with article 5 one-fourth as long as article 6, the latter very elongated, with hindedge fully excavated, forming a false transverse palm by the projection of a large tooth at the distal end, proximal part of hindedge bearing a small triangular lobe, article 7 overlapping the false palm by more than half its length, bearing an inner proximal bump; article 2 of gnathopod 2 strongly inflated, article 3 bearing a sharp, slender anterior lobe, article 4 bearing a distally projecting acute posterior process, article 6 shorter than 5, palm poorly developed, oblique, bearing a defining spine; ventrum of pereonal segment 2 bearing a large sternal spine projecting posteriorly as seen on the lateral drawing of the animal.

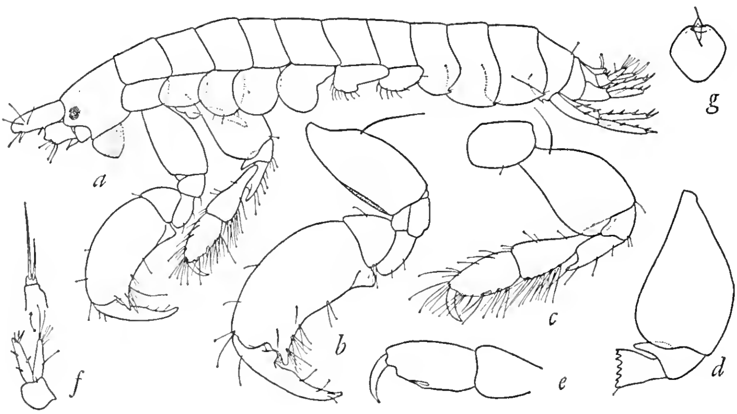

Figure 27.—*Lembos bryopsis*, new species, holotype, male, 6 mm., Reish sta. E–40: *a*, lateral view; *b*, gnathopod 1; *c–e*, gnathopod 2; *f*, uropod 3; *g*, telson.

Mouthparts similar to those of *L. websteri* in Sars (1895, pl. 194). Uropod 3 with a small second article on the outer ramus; false lobes of telson quite erect but flattened in the drawing; peduncles of both first and second uropods with an apical ventral tooth, smaller in second uropod. All pereopods and most of antennae missing.

Holotype: USNM 107575, male, 6 mm. Unique.

Type locality: Reish station E–40, Eniwetok Atoll, Aug. 27, 1956.

Relationship: The only other species of *Lembos* bearing an inflated second article on gnathopod 2 is *L. kergueleni* (Stebbing 1888, pl. 111), but the new species differs from it markedly in the first gnathopod and the rounded first coxa.

No other known species of the genus has a first gnathopod similar to *L. bryopsis*.

A single female was associated with this male animal in Station E–40 but the writer considers that it belongs temporarily with *L. aequimanus*.

Distribution: Eniwetok Atoll, Marshall Islands.

Lembos processifer (Pirlot)

FIGURES 28 *g–m*

Bemlos processifer Pirlot, 1938, pp. 330–334, figs. 147–149.

Material: Abbott stations 31–D–2 (2), 76–H–3 (3), 124–D–3 (2), 128–C–5 (1), 160–165–J–5 (1), 176–G–4 (3), 177–G–5 (2), 179–184–M–1 (3); ? Reish station E–163 (1 female).

Remarks: Females and juveniles of this species have the enlarged sixth article of gnathopod 1 similar to the male, and article 5 is shortened, so that these animals are relatively easy to separate from females of *Microdeutopus tridens* (figure 27*f*).

Pirlot's (1938) figure 149 of the female second gnathopod is really the first gnathopod of a small female. In the present materials gnathopod 2 of the female is similar to that of the male gnathopod 2.

Lembos processifer and *L. intermedius* Schellenberg (1938a) appear identical except for the pointed first male coxa of *L. intermedius*. None of the specimens at hand shows any tendency to a pointed first coxa; because this feature is presently a necessary part of any key to *Lembos*, *L. intermedius* from the Hawaiian Islands and *L. processifer* from Micronesia and the Celebes are conserved; nevertheless, their life histories should be fully studied for evidence of intergradation and subspeciation.

For future reference it may be noted that *L. intermedius* was described in June of 1938 and *L. processifer* in October of 1938. The date of publication apparently is missing on Pirlot's paper, at least on the several copies from U.S. libraries available to the writer. The publisher, E. J. Brill, Ltd., Leiden, has kindly informed me that their records show October 1938 as the publication date of Pirlot's paper.

Distribution: Celebes; Ifaluk Atoll, Caroline Islands.

Lembos species

FIGURES 28*a–e*

cf. *Lembos francanni* Reid, 1951, pp. 254–255, fig. 46.

Material: Abbott stations 32–G–3 (1), 116–F–3 (5), 128–C–5 (1). ?Reish stations E–133 (1), E–169 (1), E–172 (3).

Remarks: Two minor differences are seen in the present specimens when compared with the description and figures by Reid from West

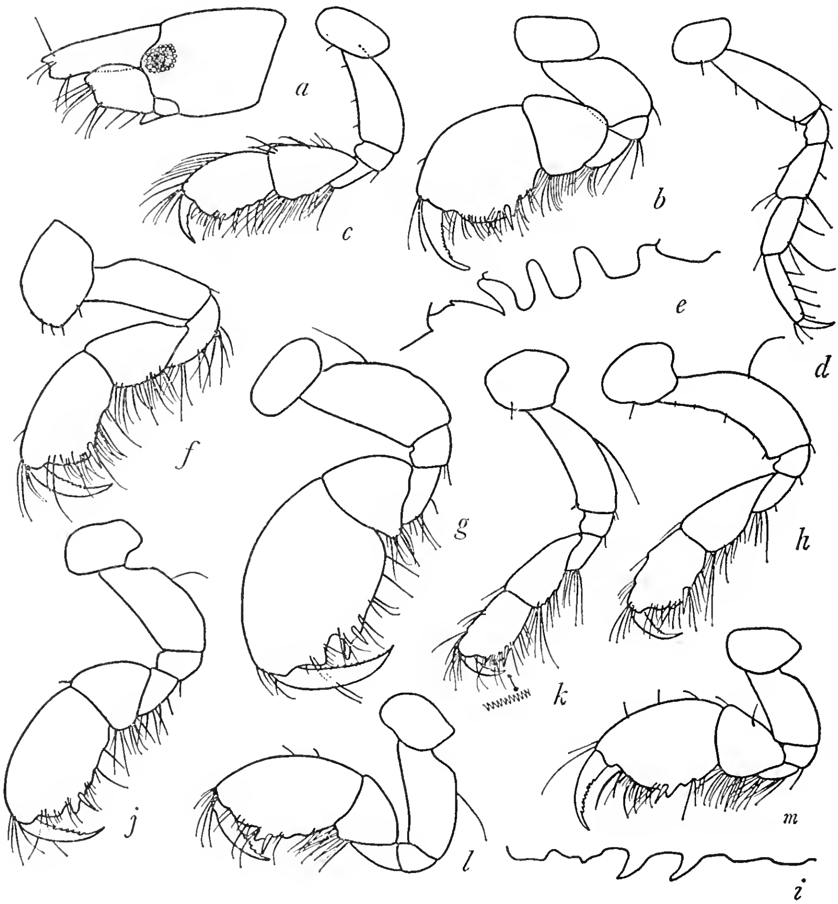

FIGURE 28.—*Lembos* species, male, 2.6 mm., Abbott sta. 116–F–3: *a*, head; *b,c*, gnathopods 1, 2; *d*, pereopod 1; *e*, ventral spination of peraeon segments 1–6. *Microdeutopus tridens* Schellenberg, female, 3.5 mm., Abbott sta. 31–D–2: *f*, gnathopod 1. *Lembos processifer* Pirlot, male, 3 mm., Abbott sta. 179–184–M–1: *g,h*, gnathopods 1, 2; male, 4 mm., Abbott sta. 176–G–4: *i*, ventral spination of peraeon segments 1–6; male, 3 mm. Abbott sta. 179–184–M–1: *j,k*, gnathopods 1, 2; male, 2.75 mm., Abbott sta. 179–184–M–1: *l*, gnathopod 1; female, 2.5 mm., Abbott sta. 176–G–4: *m*, gnathopod 1.

Africa: (1) the lack of an anterodistal process on article 2 of gnathopod 2, perhaps due to immaturity, and (2) the spinose inner edges of the dactyls on both gnathopods, perhaps overlooked by Reid. The male has a spiniform median keel on the sternites, commencing on segment 1 and ending on segment 5, with a slight keel on segment 6, as drawn.

It is impossible to separate females of this species from females of *L. processifer* as herein identified, and only where males of *Lembos* species have occurred can some distinction be made between the species. Essentially, the males of this species resemble large females of *L. processifer* except for the ventral keel and lack of brood plates; that these specimens are not simply aberrant intersexes of *L. processifer* is demonstrated by the difference in ventral keels as seen in the accompanying drawings.

Distribution: Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Genus *Microdeutopus* Costa

Microdeutopus tridens Schellenberg

FIGURE 28*f*

Microdeutopus tridens Schellenberg, 1938a, pp. 74–75, fig. 38.

Material: Abbott stations 31–D–2 (2), 32–G–3 (1), 40–E–3 (1), 41–D–3 (2), 42–F–2 (1), 81–B–4–d (4), 112–I–5 (1), 113–H–2 (10), 126–C–4 (3), 132–E–4 (1), 136–C–4 (1), 137–E–6 (9), 138–E–4 (4), 141–D–3 (2), 146–151–H–4 (1), 155–157–G–1 (2), 158–159–D–5 (7), 167–D–4 (3), 176–G–4 (4), 177–G–5 (8), 179–184–M–1 (35), 192–D–6 (2); Bayer stations 592 (1), 754 (1); Reish station E–24 (1).

Remarks: The female first gnathopod is drawn for comparison with that of female *Lembos processifer* (figure 27 *m*).

Distribution: Gilbert Islands; Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Family Photidae

Genus *Eurystheus* Bate

Audulla Chevreux, 1901, pp. 431–432. [New synonymy.]
Eurystheus Bate.—Stebbing, 1906, p. 610.

Such multispecific genera have always caused difficulty to taxonomists, especially because of apparent intraspecific polymorphism. Notably this has been true of the species *E. atlanticus* (Stebbing 1888) and *E. afer* (Stebbing 1888). As originally described and figured by him, they seemed to be clearly distinct although, at the time, Stebbing thought they might be varieties of a single species. *Eurystheus afer* bears short lateral head lobes, scarcely distinct from the front head

margins and only slightly attenuated below and distally, with an oblong eye filling the anterior part of the head fully along the anterior margin. *Eurystheus atlanticus* bears a strongly produced lateral head lobe with a lageniform eye, the lower part of the eye filling the lateral lobe and the neck reaching upward toward the top of the head. Since that time, the two species have been recorded frequently and a few more figures have been published but the interpretations have strayed far from the original interspecific concepts of the genus. It becomes practically impossible for the taxonomist to assign names to populations in areas other than the type locality, South Africa.

The two species, their varieties, and similar phenotypes have now been reported from as far east as Micronesia, half a world away from the type locality.

Stebbing's concept of differences based on eyes was destroyed by Tattersall (1922), who reported *E. atlanticus* with well-produced head lobes that mixed together specimens having oval eyes entirely confined to the lobes with specimens having lageniform eyes with a neck stretched up onto the head proper. Apparently the lageniform eye was associated with a terminal condition of adulthood. Chilton (1921) reported specimens with the lageniform necks nearly obsolete, but perhaps these should be considered as rudimentary necks just developing rather than becoming obsolete.

Walker (1909) decided that his *E. gardineri* and *E. zeylanicus* were synonyms of *E. atlanticus*, bringing in species with variable eyes or oval eyes confined to the head lobes. Thus, *E. afer* and *E. atlanticus* differed basically by the amount of forward production of the head lobe, *E. afer* with an oblong eye, *E. atlanticus* either with an oval eye confined to the large head lobe or with a neck extending onto the head.

Then Pillai (1957) figured both species, distinctly showing a difference in sizes of head lobes, with oval eyes for *E. atlanticus* and slightly oblong eyes for *E. afer*. Eyes of the latter species somewhat resembled a modified version of a lageniform eye intermediate between the original *E. atlanticus* and *E. afer* of Stebbing.

J. L. Barnard (1961) figured a specimen assigned to *E. afer* having head lobes similar to those of Stebbing's *E. afer* but with modified lageniform eyes as shown by Pillai.

Present materials provide an unusual population assignable to *E. atlanticus* and carrying well-produced head lobes, oval eyes, and male gnathopods within varietal extremes of *E. atlanticus*. Female gnathopods, however, are identical to those of the male, a condition not heretofore described. Apparently this is a distinct phenotype, but whether it is sufficiently distinct to prevent interbreeding is unknown of course. Another group of specimens is composed only of females

having lageniform eyes but head lobes intermediate in shape between *E. afer* and *E. atlanticus*. Provisionally these specimens have been assigned to *E. pacificus* Schellenberg (1938a), a species described as having the eyes and head lobes of Stebbing's *E. atlanticus* but exhibiting quantitative gnathopodal differences. The gnathopods are smaller in both sexes, with the male second gnathopodal finger overlapping the less oblique palm and the female gnathopod lacking the definition seen in *E. atlanticus*. Schellenberg did not figure the head and eyes. The head lobes of the present specimens are clearly discernible from those of *E. atlanticus* and *E. afer* as described by Stebbing but approach closely Pillai's figure of the head of *E. afer*.

Another species, *Eurystheus imminens* K. H. Barnard (1916 and 1937), is probably a mutant of *E. atlanticus* and is based on a slight difference in palmar tooth structure of the male second gnathopods.

If the specimens herein assigned to *E. pacificus* are really what Schellenberg described, then Micronesia supports a mutant form of *E. atlanticus* and a distinct but close relative, *E. pacificus*, bearing close resemblance to *E. afer*, because of its intermediate head and eyes.

Probably a complex of specific populations exists, each maintaining separation in different geographical areas but assuming different morphological appearances in distantly separated regions. Simply stated, species A in area 1 approaches the morphology of species B in area 2 but species B in area 1 is quite distinct from species B in area 2; hence, it differs notably from species A.

The genus *Audulla* was described originally by Chevreux in the family Ischyroceridae but Stebbing (1906) correctly listed it as a photid. In the Photidae, *Audulla chelifera*, the type species, keys out to the genus *Eurystheus* Bate. A comparison of *A. chelifera* with *Eurystheus maculatus* (=*E. tridentatus*), the type species of *Eurystheus*, shows that male *Audulla* differs from male *Eurystheus* by the following characters: the stouter second antennal flagellum, the very short fifth article of gnathopod 2 and the transverse semichelate palm of gnathopod 2. Since 1901 a number of species of *Eurystheus* have been described carrying a second gnathopod approaching the transverse palm and even the semichelate condition of *Audulla*. The condition in *Audulla* might be interpreted as a coarse defining tooth with a medial excavation which, in a qualitative sense, is scarcely different from some of the following species: *Eurystheus lina*, *E. semichelatus*, *E. crassipes*, *E. chiltoni*, *E. longimanus*, *E. scissimanus*, and *E. abyssalis*. The following three species have a shortened fifth article of gnathopod 2: *E. anamae*, *E. ostroumowi*, and *E. lobatus*. The gnathopods of *E. semichelatus* and *E. lina* are notably similar to *Audulla;* hence, only the stoutness of the second antennal flagellum remains as a

distinction between the two genera and I regard this as a minor, quantitative feature, of no generic value. The submergence of *Audulla* in *Eurystheus* is recommended.

The following species are peculiar in that the telson is deeply emarginate: *E. lina*, *E. chiltoni*, and *E. haswelli*. The wide variation of characteristics in *Eurystheus*, particularly in the gnathopods, suggests that such variability of the telson is specifically inconsequential in the genus. On the other hand these may represent cases where only the upper part of the telson has been observed while the lower posterior flap of the telson was not seen or drawn.

Eurystheus atlanticus (Stebbing), aberrant form

FIGURE 29

Gammaropsis atlantica Stebbing, 1888, p. 1101, pl. 114.
Gammaropsis zeylanicus Walker, 1904, pp. 282–283, pl. 6, fig. 41; 1909, p. 339.
Gammaropsis Gardineri Walker, 1905, pp. 929–930, pl. 88, figs. 11–14, 16, 17.
Eurystheus atlanticus.—Stebbing, 1906, p. 611; 1908, pp. 86–87, pl. 40B; 1910a, p. 461; 1910b, p. 614, 648.—Chilton, 1921, p. 81.—Tattersall, 1922, pp. 10–11, pl. 1, figs. 17–20.—Schellenberg, 1926, pp. 375–376.—Hale, 1927, p. 315.—Chevreux, 1927, pp. 110–111.—Hale, 1929, p. 223, fig. 220.—Chevreux, 1935, p. 126.—K. H. Barnard, 1937, p. 164.—Pirlot, 1938, pp. 345–346.—Reid, 1951, p. 258.—Pillai, 1957, pp. 56–57, fig. 14.—Ruffo, 1959, p. 19.

Materials: Reish stations E–45 (1), E–145 (10).

Remarks: Apparently this species is most variable, especially in its eyes, ranging from lageniform to flask-shaped to oval. The type

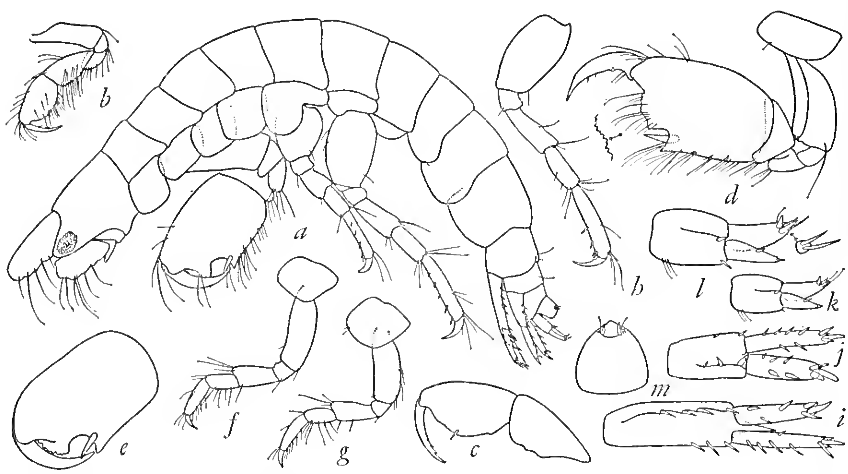

FIGURE 29.—*Eurystheus atlanticus* (Stebbing), female, 4.5 mm., Reish sta. E–142: *a*, lateral view; *b,c*, gnathopod 1; *e*, gnathopod 2, lateral view; *f–h*, pereopods 1, 2, 5; *i–l*, uropods 1, 2, 3, 3; *m*, telson; male, 4 mm.: *d*, gnathopod 2.

specimen had lageniform eyes; Chilton (1921) reported nearly oval eyes with only a remnant of the neck; Walker (1905) had the oval-eyed form and Tattersall (1922) had both lageniform and oval-eyed specimens.

The present specimens have oval eyes but, in addition, they are unique because the females have gnathopods like those of the male, with an excavate palm. See discussion under the generic heading (p. 531).

Distribution: Tropical Atlantic; Red Sea; Indo Pacific, previously known eastward through Indonesia; Eniwetok Atoll, Marshall Islands.

Eurystheus digitatus Schellenberg

FIGURE 30

Eurystheus digitatus Schellenberg, 1938a, pp. 84–86, fig. 44.

Material: Abbott stations 13–C–1 (1), 14–B–3 (11), 19–E–3 (3), 28–D–3 (5), 31–D–2 (1), 32–G–3 (2), 39–E–5 (3), 41–D–3 (1), 66–E–10 (3); Reish stations E–40 (1), E–68 (1).

Material, females only: Abbott stations 15–C–2 (2), 42–F–2 (2), 46–E–2 (2), 49–E–2 (2), 83–E–1 (2); Reish stations E–20 (1), E–24 (4), E–28 (1), E–38 (1), E–41 (1), E–93 (4), E–96 (1), E–137 (4).

Remarks: The dubious females have been compared with other material in which females are associated with males and correspond with them. A possible difficulty in distinguishing these females from as yet undescribed females of *E. setiferus* Schellenberg (1938a) should be pointed out. According to Schellenberg, males of *E. setiferus* are

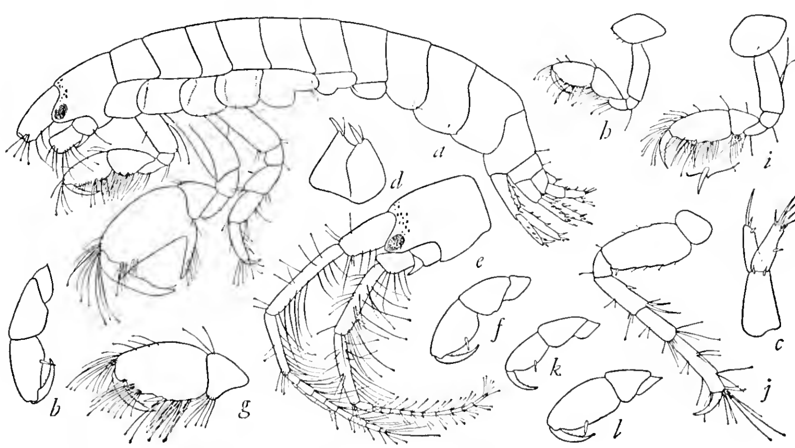

FIGURE 30.—*Eurystheus digitatus* Schellenberg, male, 3.7 mm., Reish sta, E–40: *a*, lateral view; *b*, gnathopod 1; *c*, uropod 3; *d*, telson; ?female, 5 mm., Reish sta. E–93: *e*, head; *f,g*, gnathopods 1, 2; female, 3 mm., Abbott sta. 15–C–2: *h,i*, gnathopods 1, 2; *j*, pereopod 5; female, 3.4 mm., Reish sta. E–93: *k,l*, gnathopods 1, 2.

especially noticeable by the very setose pereopods but the males and females of *E. digitatus* also are conspicuous for this condition; such was not mentioned by Schellenberg. Because of the lack of male *E. setiferus* in the collections, all of these "*E. setiferus*" females have been identified as *E. digitatus* since that species is abundantly represented by males.

One way to identify females of this species is by the spots of pigment forming a crown around the top of the head above the eyes; both males and females often have these small spots and no other male of *Eurystheus* in the collections has these. The spots are not to be likened to stray ommatidia but are distinct, small, irregular blots of pigment below the chitin; however, not all otherwise easily recognizable males have these spots in alcohol and so complete reliance cannot be made on them.

Distribution: Gilbert and Ellice Islands; Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Eurystheus ?pacificus Schellenberg

FIGURE 31

Eurystheus pacificus Schellenberg, 1938a, pp. 80–82, fig. 42.

Material: Abbott stations 72–G–3 (2), 155–157–G–1 (1), 160–165–J–5 (1), 197–198–F–1 (10); Reish station E–41 (2).

Remarks: All the specimens collected are females. In one case the female was associated with a male of *Megamphopus abbotti*, new

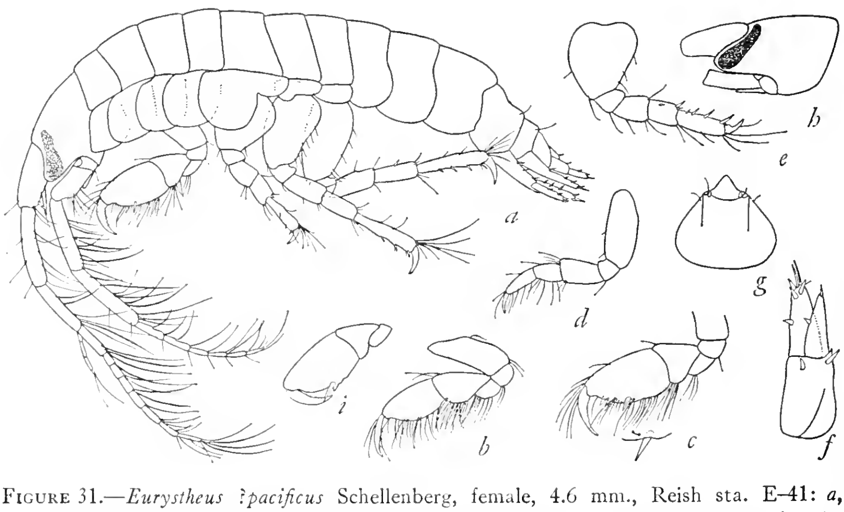

FIGURE 31.—*Eurystheus ?pacificus* Schellenberg, female, 4.6 mm., Reish sta. E–41: *a*, lateral view; *b*,*c*, gnathopods 1, 2; *d*,*e*, pereopods 1, 3; *f*, uropod 3; *g*, telson; female, 4 mm., Abbott sta. 72–G–3: *h*, head; *i*, gnathopod 2.

species, which may indicate that the specimens are very large females of *M. abbotti*, but the shape of the lateral lobes on the head and the bleached condition of the eyes and head mark these specimens strongly from *M. abbotti*. Only one bleached male of *M. abbotti* has been discovered. The first point of difficulty is that the present specimens of *E. pacificus* have 3–4 large spines on the posterior edge of article 6 on pereopod 3 just as in *M. abbotti*; this has never been indicated for *E. atlanticus* or *E. pacificus* but has been shown for *E. afer* (Stebbing, 1888, pl. 114).

The second point of difficulty is that Schellenberg (1938a) has described *E. pacificus* as having eyes and lateral head lobes resembling *E. atlanticus* by Stebbing (1888). The lateral lobes of the present specimens are not as produced as in *E. atlanticus* (compare figures herein, Stebbing 1888, Walker 1905 of *E. gardineri*, and Pillai 1957). Yet they are not quite as short as in *E. afer* (Stebbing 1888, and J. L. Barnard 1961) but are more like those of *E. afer* as figured by Pillai (1957). Most certainly the specimens at hand are distinct from the *E. atlanticus* cited herein and are distinct from Stebbing's and J. L. Barnard's portrayals of *E. afer*. They cannot be firmly set as *E. pacificus*, since males are not present; the second gnathopods are like those of the female of *E. pacificus* as drawn by Schellenberg (1938a) with one exception: an animal from 72–G–3 has the second gnathopod approaching that of *E. atlanticus* as figured by Schellenberg, wherein a distinctly defined palm is shown.

See the remarks on this problem in the introduction to this genus.

Distribution: Ellice, Gilbert, and Marshall Islands; Nauru; Ifaluk Atoll, Caroline Islands.

Genus *Megamphopus* Norman

Megamphopus abbotti, new species

Figure 32

Diagnosis: Lateral lobes of head not pedunculate, projecting conically forward, eyes dark, sublageniform; accessory flagellum 2-articulate; palm of gnathopod 2 transverse, with a small excavation and large spine near the defining angle of the palm, article 7 stout, apically incised; uropod 1 with a long peduncular tooth as long as the outer ramus, uropod 2 lacking tooth; telson rounded apically, with 2 false dorsal lobes, each armed with a spine and a seta.

Female: Gnathopod 2 with slightly oblique palm cut into minute subcastellations, with a tooth and a large spine at lower corner.

The head and body are moderately stained with diffuse pigment, especially around the dark eyes.

Holotype: USNM 105872, male, 2.75 mm.

Type locality: Abbott station 166–G–3, Ifaluk Atoll, Oct. 25, 1953.

Material: Abbott stations 160–165–J–5 (1), 166–G–3 (6); Reish station E–45 (1).

Relationship: Although technically this species belongs to the genus *Megamphopus* as revised by J. L. Barnard (1962a), it bears closer

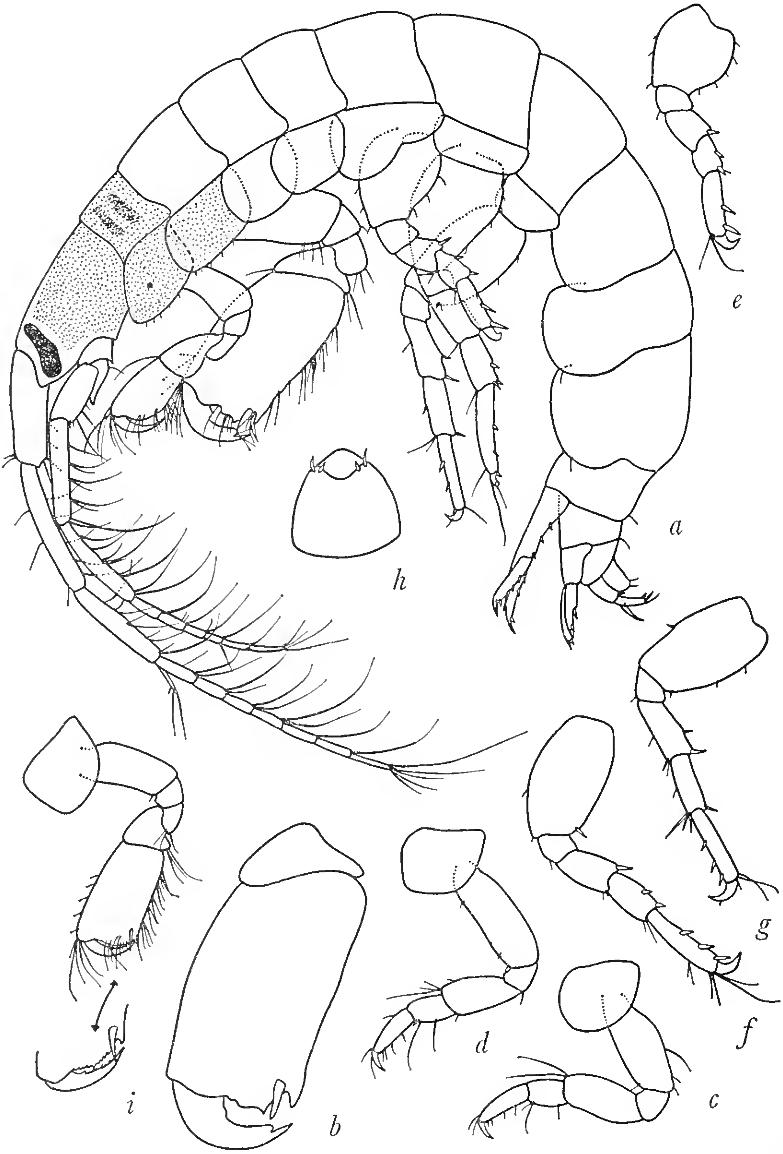

FIGURE 32.—*Megamphopus abbotti*, new species, holotype, male, 2.75 mm., Abbott sta. 166–F–3: *a*, lateral view; *b*, gnathopod 2; *c–g*, pereopods 1, 2, 3, 4, 5; *h*, telson; female, 3 mm.: *i*, gnathopod 2.

relationship to several species of *Eurystheus*. This relationship involving gnathopods, head, and eyes further points to the artificiality of the arrangement made by J. L. Barnard and the difficulty in separating several photid genera. The accessory flagellum is bi-articulate whereas the genus *Eurystheus* has a 3+ articulate flagellum. No species of *Megamphopus*, as listed by J. L. Barnard (1962a), has yet been found in the Indo-Pacific and *M. abbotti* is apparently simply a *Eurystheus* that has lost one more flagellar article.

This species differs from *Eurystheus semichelatus* K. H. Barnard (1957) and *E. lina* Kunkel (1910) by not having a distinctly semichelate second gnathopodal palm; from *E. crassipes* Haswell (1880) by the longer, narrower sixth article of gnathopod 2, bearing a nonexcavate palm; from *E. scissimanus* K. H. Barnard (1925) by the lack of a medial palmar excavation on gnathopod 2. It differs from *E. minutus* Chevreux (1926) by the more elongated eyes, the narrower, more elongated sixth article of gnathopod 2, and the slightly different palmar configuration.

Because of the eye structure this species is easily confused with *Eurystheus afer* (Stebbing 1888) but the palm of the second gnathopod in *E. afer* is oblique and article 6 is not as rectangular.

Distribution: Ifaluk Atoll, Caroline Islands; Eniwetok Atoll, Marshall Islands.

Family Ampithoidae

Key to Genera

1.	Mandible lacking palp	**Sunamphitoe**
	Mandible bearing palp	2
2.	Antenna 1 lacking accessory flagellum	3
	Antenna 1 bearing accessory flagellum	6
3.	Gnathopod 1 larger and stouter than gnathopod 2	**Exampithoe**
	Gnathopod 1 smaller and more slender than gnathopod 2	4
4.	Gnathopods feeble, chelate	**Macropisthopus**
	Gnathopods large, subchelate	5
5.	Article 6 of pereopods 3–5 widened apically	**Pleonexes**
	Article 6 of pereopods 3–5 not widened apically	**Ampithoe**
6.	Outer ramus of uropod 3 bearing 1 hook	**Amphithoides**
	Outer ramus of uropod 3 bearing 2 hooks	7
7.	Gnathopod 1 larger than gnathopod 2	**Paragrubia**
	Gnathopod 1 smaller than gnathopod 2	**Cymadusa**

According to this key, *Ampithoe megaloprotopus* Stebbing (1906, p. 633) should be transferred to *Exampithoe*. *Amphitholina* Ruffo was transferred to the family Eophliantidae by Gurjanova (1958).

Genus *Ampithoe* Leach

Ampithoe ramondi Audouin

Ampithoe ramondi Audouin.—J. L. Barnard, 1955, pp. 28–29 (with references).

Material: Hand station CH–551 (1); Reish stations E–6 (3), E–13 (1), E–20 (2), E–24 (6), E–26 (6), E–44 (1), E–72 (6), E–74 (3), E–82 (8), E–94 (2), BE–103 (2), BE–104 (1), E–116 (1), E–127 (10), E–128 (11), E–129 (1), E–143 (5), E–144 (24), E–145 (9), E–171 (14), E–172 (5), E–184 (4).

Distribution: Pantropical.

Genus *Cymadusa* Savigny

Cymadusa brevidactyla (Chevreux)

Grubia brevidactyla Chevreux, 1907, pp. 416–417; 1908, pp. 517–521, figs. 30–32.—Schellenberg, 1938a, p. 87.

Material: Bayer station 628 (2).

Remarks: The single adult is a female, the other specimen a juvenile. The female is distinguishable from females of *C. filosa* by the very narrow hindlobe of article 5 on gnathopod 2.

Distribution: Gambier and Tuamotu Archipelagos; Gilbert and Ellice Islands; Nauru; Ifaluk Atoll, Caroline Islands.

Cymadusa filosa Savigny

Cymadusa filosa Savigny.—J. L. Barnard, 1955, pp. 29–30, fig. 15 (with references).—Ruffo, 1959, p. 19.

Material: Abbott stations 19–E–3 (1), 23–E–2 (1), 42–F–2 (2), 76–H–3 (1), 83–E–1 (1), 84–D–1 (8), 90–C–4 (2), 91–E–2 (4), 95–L–4 (2), 112–I–5 (1), 113–H–2 (1), 116–F–3 (1), 123–D–2 (7), 139–C–2 (1), 144–F–2 (2), 145–C–3 (5), 177–G–5 (7), 179–184–M–1 (11), 192–D–6 (1); Bayer station 588 (1); Reish stations E–2 (1), E–6 (2), E–15 (1), E–25 (5), E–38 (41), E–40 (5), E–41 (1), E–42 (2), E–48 (2), E–50 (2), E–55 (4), ME–57 (1), ME–60 (7), E–75 (4), E–81 (6), E–82 (2), E–95 (2), BE–109 (7), BE–114 (6), E–119 (1), E–120 (1), E–128 (1), E–129 (4), E–136 (4), E–163 (1), E–171 (4), E–172 (8).

Remarks: Ruffo (1959) expressed doubt that materials reported by J. L. Barnard (1955) from the Hawaiian Islands are indeed this species because of the poorly setose gnathopods; Barnard's figures of the apparently young male correspond with Shoemaker's (1935, figs. 5g, h) figures of the female. Apparently, the fully setose condition is characteristic of aged males and none of these has been seen by me from the tropical Pacific, except those found on floating debris.

Distribution: Tropical and warm-temperate cosmopolitan.

Genus *Paragrubia* Chevreux

Paragrubia vorax Chevreux

FIGURE 33

Paragrubia vorax Chevreux, 1901, pp. 427–431, figs. 50–55.—J. L. Barnard, 1955, pp. 31–34, fig. 17 (with references).

Material: Reish stations E–6 (3), E–20 (8), E–38 (1), E–43 (2), E–55 (2), E–76 (1), E–83 (14), E–85 (1), E–93 (3), BE–107 (2), E–120 (2), E–136 (1).

Remarks: Externally, the young of this species are difficult to separate from several species of the Aoridae. Of course, the principal character of the Ampithoidae is the notched outer lobes of the lower lip but this requires dissection of each specimen. The attached third uropods are quite like those of some aorids. The outer ramus of the third uropods in most Ampithoidae clearly bears one or two spine-hooks but those of *Paragrubia* are nearly straight or scarcely hooked

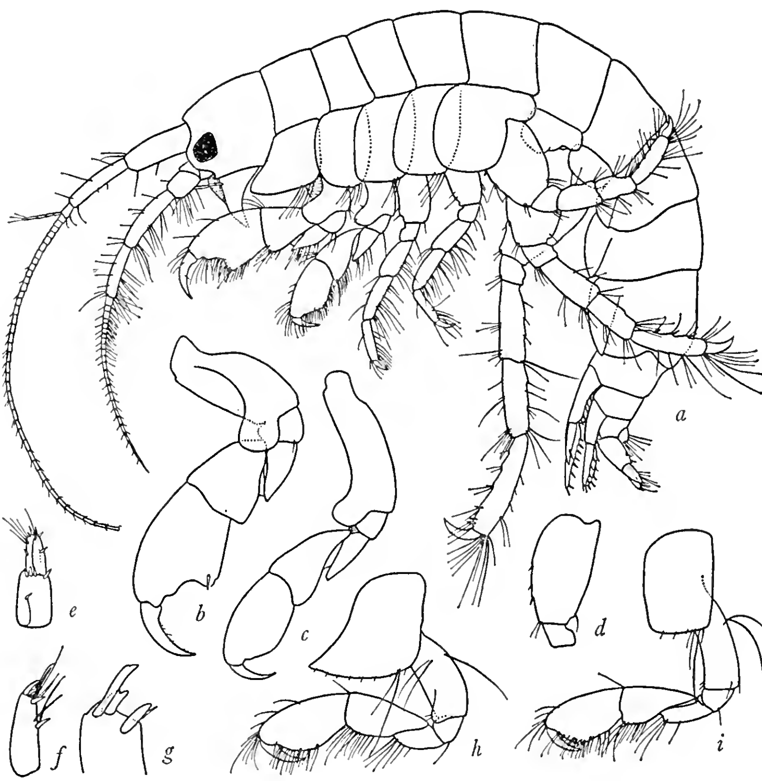

FIGURE 33.—*Paragrubia vorax* Chevreux, male, 9 mm., Reish sta. E–20: *a*, lateral view; *b,c*, gnathopods 1, 2; *d*, pereopod 5; *e*, uropod 3; *f,g*, outer ramus of uropod 3; juvenile 5.5 mm.: *h,i*, gnathopods 1, 2.

and not easy to recognize as normally ampithoid. Thus, the genus is easily confused with aorids because it is an ampithoid with enlarged first gnathopods. Young of the species resemble *Microdeutopus tridens*, with which they might be confused on the basis of the acutely produced first coxa. From various species of *Lembos* they are segregated by the very slender, poorly setose mandibular palps, which can be seen projecting anteriorly below the second antennae; species of *Lembos* have well-developed palps with falcate, setose third articles.

Distribution: Indo-Pacific tropical.

Genus *Pleonexes* Bate

Pleonexes (?) Species

Figure 34

Diagnosis: Antennae missing; eyes large, nearly round; article 5 of gnathopod 1 shorter than 6, the palm of article 6 oblique; gnathopod 2 with anterodistal edge of article 2 produced into a large leaflike process, article 5 very short, lobate, article 6 large, as broad as long, palm nearly transverse, slightly convex, lacking defining spine, article

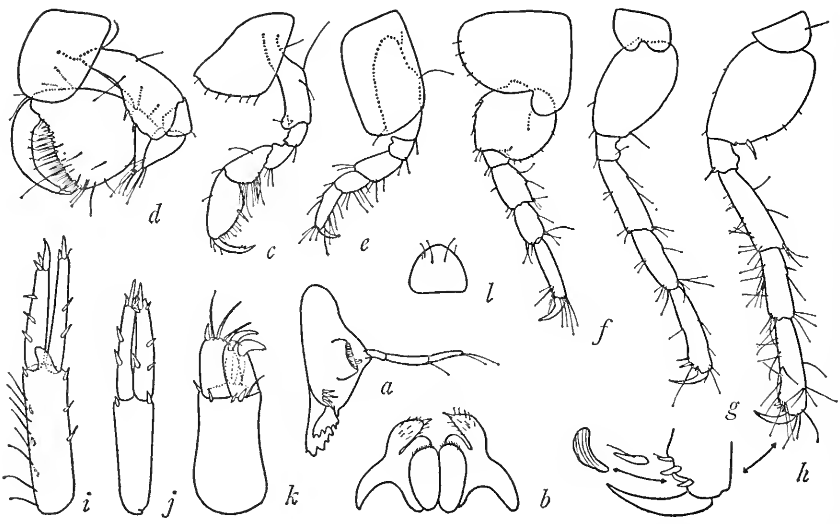

Figure 34.—*Pleonexes* species, male, 4 mm., Abbott sta. 141–D–3: *a*, mandible; *b*, lower lip; *c*,*d*, gnathopods 1, 2; *e*–*h*, pereopods 1, 3, 4, 5; *i*–*k*, uropods 1, 2, 3; *l*, telson.

7 curved, fitting palm; article 2 of pereopods 1–2 stout, article 4 not produced in front; pereopods 3–5 with distal end of article 6 slightly widened, bearing 4 stout teeth, one of which is folded back on the false palm and is heavily striated; article 2 of pereopod 3 with stout proximal anterior spine; uropods 1 and 2 with spines on both rami, spines sparse on peduncles; telson linguiform, rounded apically, lacking large hooks.

Material: Abbott station 141–D–3 (1).

Remarks: It is questionable that this species is a *Pleonexes* because of the telson lacking the hooks seen in *P. gammaroides* and *P. lessoniae*. It may prove that the telson is the only qualitative feature distinguishing *Pleonexes* from *Ampithoe* because the widening of the sixth article on pereopods 3–5 is quantitative and occasionally approached by several species of *Ampithoe*. The mouthparts are similar to *P. gammaroides* (Sars, 1895, pl. 207) except for the mandible and lower lip, figured herein. The mouthparts are quite distinct from those of *P. lessoniae* (Hurley, 1954). This specimen differs from any known species of *Ampithoe* by its peculiar second gnathopods.

Distribution: Ifaluk Atoll, Caroline Islands.

Family Podoceridae

Genus *Podocerus* Leach

To gain any concept of this genus and the limits of variation within a species is nearly impossible at the present time as seen in the following discussion and J. L. Barnard's (1962a) remarks. The earliest described species, *P. brasiliensis* (Dana, 1853), *P. lobatus* (Haswell, 1885), *P. laevis* (Haswell, 1885), and *P. cristatus* (Thomson, 1879), were not well detailed. Apparently overlooked in the last 3 species were the proper configurations of the teeth on male gnathopod 2. Later identifications of *P. laevis* by Walker (1904) and Chilton (1926) differ completely in the respective absence and presence of 3 widely separated teeth on the male gnathopod 2 palm; Walker's figure is more like the original description. Chilton's (1926) figure of male gnathopod 2 on *P. cristatus* establishes the species. On the other hand J. L. Barnard's (1959) figure of *P. brasiliensis* probably shows a younger stage of this same gnathopod, yet he was able to distinguish *P. brasiliensis* as a common harbor-dwelling, noncristate amphipod from a related cristate species, occurring more commonly in the open sea. The latter resembles *P. cristatus* in the dorsal keel but bears only one palmar tooth on gnathopod 2. Pirlot (1938) showed the wide variation in dorsal carination of two other species, hence demonstrating its uselessness. For the time being we must resort to gnathopodal configurations as specific criteria. Pirlot's (1938) figure of *P. lobatus* most certainly appears distinct from Haswell's original figures. The commonly reported *P. brasiliensis* has never been refigured since it was redescribed by Walker (1904) as *P. synaptochir*, except by J. L. Barnard (1959). Indeed Barnard's identification may be erroneous and the specimens might be named as *P. variegatus* Leach. K. H. Barnard (1916) suggested that *P. variegatus* and *P. brasiliensis* may be identical, a reasonable opinion.

It is easy to imagine that such species as *P. mangarevae* Chevreux (1908), *P. senegalensis* Chevreux (1926), and *P. zeylanicus* (Walker 1904) are simply variants and the relationship of this complex is very close to *P. chelonophilus* (Chevreux and de Guerne).

A study of variation and growth stages based on topotype materials is needed in this group before the taxonomy can be clarified.

Podocerus talegus, new species

FIGURE 35

Diagnosis of male: Eyes large; palm of gnathopod 1 bulbous, slightly longer than hindmargin of article 6, bearing stout setae; anterodistal end of article 2 on gnathopod 2 with a large lobe, article 4 acutely produced, article 6 slightly elongated, anterior edge convex, posterior edge nearly straight, palm not distinct from hindmargin, bearing 2 small bumps and a crenulate margin between distal bump and hinge, article 6 reaching two thirds along hindmargin; article 2 of pereopods 1–2 not inflated; spines sparse on uropods 1–2; hinddorsal margins of pleonal segments 1 and 2 and pereonal segment 7 distinctly elevated but carinae not developed.

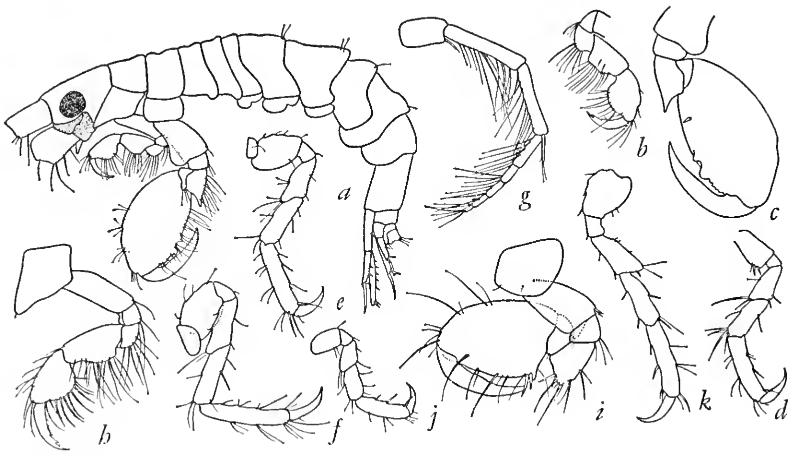

FIGURE 35.—*Podocerus talegus*, new species, holotype, male, 2.4 mm., Abbott sta. 208–C–7: *a*, lateral view; *b,c*, gnathopods 1,2 ; *d–f*, pereopods 3–5; male, 2.3 mm., Abbott sta. 41–D–3: *g*, antenna 1; female, 3 mm.: *h,i*, gnathopods 1, 2; *j,k*, pereopods 1, 5.

Female: Palm of gnathopod 2 distinct, longer than hindmargin of article 6, defined by small cusp and 2 large spines; article 4 large and produced but not as strongly as in such species as *P. mangarevae* Chevreux (1908).

Holotype: USNM 106908, male, 2.4 mm.

Type locality: Abbott station 208–C–7, Ifaluk Atoll, Sept. 30, 1953.

Material: Abbott stations 39–E–5 (1), 41–D–3 (3), 208–C–7 (7); Bayer stations 431 (1), 589 (1).

Relationship: This species bears comparison to the following species for each of which a distinguishing feature is noted:

P. cristatus: male gnathopod 2 has 3 palmar teeth near the finger hinge.

P. lobatus: male gnathopod 2 palm is defined by a tooth.

P. andamanensis: a poorly known species, needing redescription; article 4 of male gnathopod 2 not produced.

P. laevis: the original description and that of Walker (1904) have the male second gnathopodal palm straight, unarmed except for setae; the description of Chilton (1926) has the palm bearing 3 widely separated teeth.

P. inconspicuus: Pirlot (1938) has a downward produced lobe on the distal edge of article 2 on both male and female second gnathopods.

P. mangarevae: male gnathopod 1 has a narrow hindlobe on article 5; gnathopod 2 has the process of article 4 obtuse, not acute; article 4 of female gnathopod 2 is more bulbously produced; however, *P. talegus*, new species may be the young of *P. mangarevae.*

Distribution: Ifaluk Atoll, Caroline Islands.

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HEDGEHOGS AND SHREWS OF TURKEY

By Dale J. Osborn [1]

Very little has been written on the Order Insectivora (böcek yiyenler familyasi) of Turkey. Available, however, are a few reports on collections of shrews (see species discussions) as well as Wettstein's (1941) analysis of subspeciation in the European hedgehog. Some information on the natural history of Insectivora was compiled by Tolunay and Tuncok (1938). My collections have extended the known ranges of several species and added to the knowledge of their ecology and distribution.

I have written elsewhere on the geography and the vegetation of Turkey (Osborn, 1962). Several good references are Bell (1931), Neuhäuser (1936), Fisher (1950), Kosswig (1955), and the Food and Agriculture Organization of the United Nations report (1959).

I have put into parentheses equivalents of geographical and other names. The Turkish names of animals are mostly from Tolunay and Tuncok (1938). All measurements are in millimeters. The following abbreviations have been used to simplify tabulations: HBL, for head and body length; foot, for the length of the hindfoot with the claw, unless indicated otherwise; CbL, condylobasal length; RBr, rostral breadth; ZW, zygomatic width; and B.M., British Museum (Natural History).

[1] United States Naval Medical Research Unit No. 3, Cairo, Egypt, U.A.R.

My collection has been deposited in the Smithsonian Institution, United States National Museum, Washington, D.C.

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Family Erinaceidae

Hedgehogs (Kirpiler)

Erinaceus europaeus Linnaeus

Common hedgehog (adi kirpi, kandosere).

This animal is widely distributed in Europe and Asia (Ellerman and Morrison-Scott, 1951), on many of the islands in the Aegean Sea (Wettstein, 1941), and it is common to all parts of Turkey except possibly the high mountains and the open plains. On the steppe it is probably limited to the watercourses as indicated by the records from southeastern Turkey, northern Syria, Iraq, and Iran (fig. 1). The geographic range extends along the Levant southward into Israel. Bodenheimer (1958) said that "stragglers had been found as far south as Ruhama and Gaza."

The localities of the collection and the measurements of my specimens are as follows:

locality	*HBL*	*tail*	*foot*	*CbL*	*ZW*
Istanbul	204	25	43	50.0	30.5
Tarsus	209	32	50	57.2	35.9
Tarsus	137	22	39	43.3	26.2
Talas	244	24	46	57.8	37.3
Yalova	244	–	50	63.0	38.6

The facial patterns of these specimens match the illustrations of *Erinaceus europaeus roumanicus* (Herter, 1938) and the "östliche Formen" of Van den Brink (1956). The facial patterns of the specimens from Tarsus are, however, more like the Rhodes type.

Specimens from Istanbul and Yalova have a single color band on the majority of the spines. Two color bands are present on the spines of specimens from Tarsus and Talas. Single color bands have been reported from northeastern Anatolia, northern Greece, the islands of

Rhodes and Crete, Italy, Sardinia, Sicily, the Iberian Peninsula (Wettstein, 1941), Palestine (Thomas, 1918), and Lebanon (Bate, 1945) while in other parts of the range two color bands are thought to be more common. Wettstein (1953) considers that the character of a single color band is older than two color bands. Further analysis of facial patterns and the color bands on a geographical basis should be of value; however, considerably more collecting would be necessary. The number of specimens from Turkey is small and the majority are melanistic forms from the eastern Black Sea region.

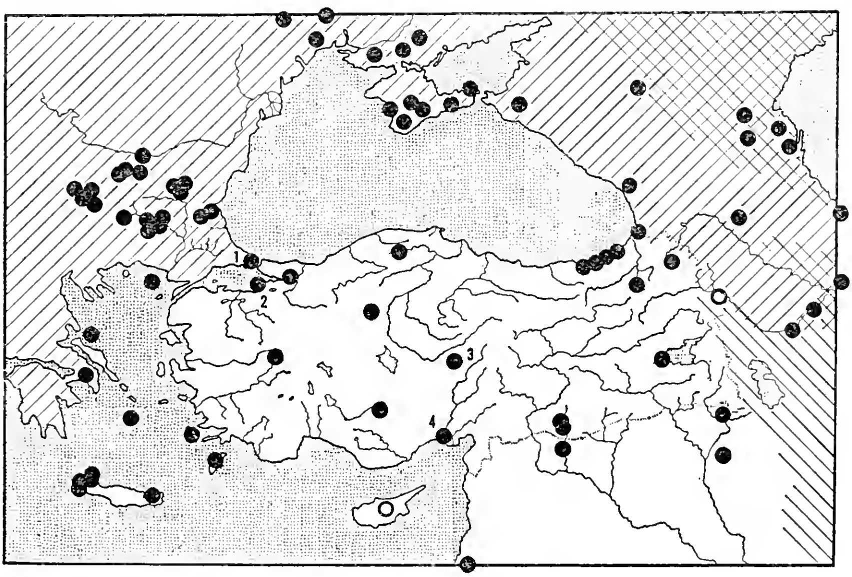

FIGURE 1

Erinaceus europaeus — probable range; ● localities of collection

Hemiechinus auritus — probable range; ○ localities of collection

new collection records: 1 Istanbul; 2 Taşköprü, Yalova; 3 Talas, Kayseri; 4 Tarsus

After Bobrinskii et al (1944), Bate (1903), Herter (1938), Van den Brink (1956), Satunin (1901), Missone (1959), Hatt (1959), Markov (1957), Wettstein (1941, 1953), Thomas (1918), Harrison (1956), Hoogstraal (1959), Hoogstraal and Kaiser (1960), and the British Museum and the Berlin Zoological Museum collections.

Hedgehogs could have moved between western Anatolia and Thrace before the formation of the Bosporus and the Dardanelles. The island collections indicate that there was interchange between Greece and Anatolia across "Aegean Land" (Pohle, 1953) (fig. 1). Wettstein (1941, 1953) considered the specimens from the Aegean Islands and Crete to show overlapping of characters from east and west.

Hemiechinus auritus Gmelin

Long-eared hedgehog (uzun kulaki kirpi).

Despite the widespread distribution of this species in southwestern Asia, it has been recorded only from Aralyk in eastern Anatolia (Satunin, 1901). It occurs on Cyprus (Bate, 1903) but *Erinaceus europaeus* does not (fig. 1).

Family Soricidae

Sharp-Nosed Mice (Sivri Burunlu Fareler)

Sorex minutus Linnaeus

Dwarf sharp-nosed mouse (sivri burunlu cüce fare), lesser shrew.

The range of this shrew includes most of Europe (Van den Brink, 1956), the western, northern, and eastern USSR, and Transcaucasia (Ellerman and Morrison-Scott, 1951). There is a collection in the

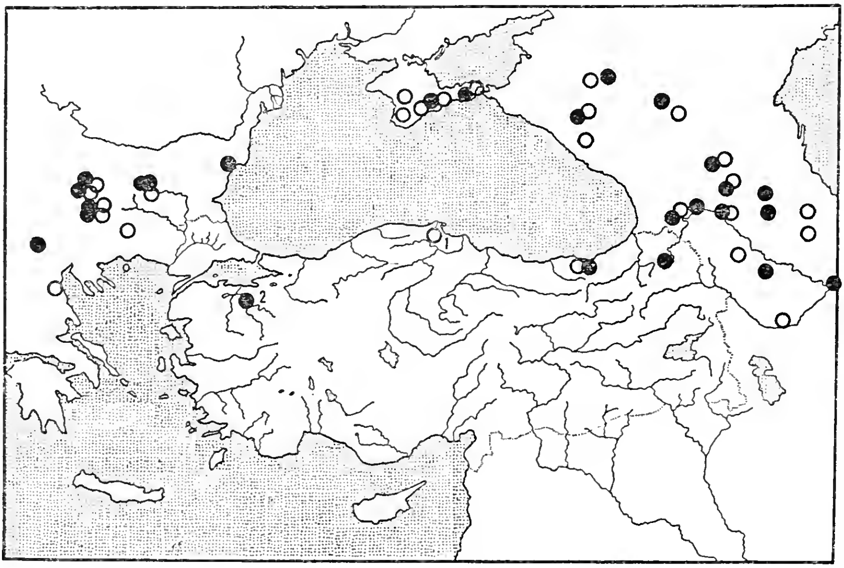

FIGURE 2

Sorex minutus — ○ localities of collection; new collection record: 1 Bürnük

Sorex araneus — ● localities of collection; new collection record: 2 Ulu Dağ

After Markov (1957), Bobrinskii et al (1944), Thomas (1913), and the British Museum collection.

British Museum (Natural History) from the mountains south of Trebizon(d) (Trabzon), Turkey. I collected three specimens from the same locality near Mereyem Ana (fig. 2) and two specimens near Bürnük, south of Sinop.

The external measurements of my specimens of *S. minutus* together with those from the British Museum collection are listed in table 1. The size of the Bürnük specimens of *S. minutus* approaches that of *S. araneus* but dental characters show that these specimens are *S. minutus*.

TABLE 1.—*External measurements of* Sorex minutus *from Turkey*

No.	Locality	HBL	Tail	Foot
526	Mereyem Ana	56	48	12
541	Mereyem Ana	64	45	12
546	Mereyem Ana	58	44	11
6.3.6.22 (B.M.)	Sumela	55	46	11*
6.3.6.23 (B.M.)	Sumela	58	43	11*
6.3.6.24 (B.M.)	Sumela	55	45	11*
6.3.6.25 (B.M.)	Sumela	55	44	11.5*
6.3.6.26 (B.M.)	Sumela	53	40	11.5*
6.3.6.27 (B.M.)	Sumela	52	42	11*
6.3.6.28 (B.M.)	Sumela	60	45	12*
6.3.6.216 (B.M.)	Sumela	54	43	11*
6.3.6.217 (B.M.)	Scalita	56	42	11*
668	Bürnük	74	35	12
677	Bürnük	67	41	12

*Without claw.

S. minutus was trapped near Mereyem Ana in burrows in the dense leaf mold under rhododendron, beside holes between rocks under the same cover, and in a spruce forest. At Bürnük I caught this shrew in a dense stand of fir.

The localities of collection indicate that this shrew could have moved into Anatolia either from the Balkans via Thrace or from the Caucasus.

Sorex araneus Linnaeus

Sharp-nosed mouse of the forest (sivri burunlu orman faresi), common shrew.

The range of this shrew is approximately that of *S. minutus*, except that it has penetrated into drier and colder habitats than the latter.

S. araneus has been collected near Miusaret, Kars district, eastern Anatolia (see reference in Ellerman and Morrison-Scott, 1951). Thomas (1913) recorded the species from "Sumela, thirty miles south of Trebizond 1,000–1,300 m." I collected seven specimens from this same location, which is now called Mereyem Ana. A single specimen was collected on Ulu Dağ in western Anatolia at about 1400 meters elevation (fig. 2).

S. araneus was trapped along with *S. minutus* in burrows under rhododendron, in spruce forest near a large rock-outcropping, and

among rocks on a steep, damp slope that supported a hardwood forest. On Ulu Dağ the specimen was trapped alongside a stream in the fir forest.

The measurements of my specimens together with those from the British Museum collection are listed in table 2.

The remark made above regarding the migratory route followed by *S. minutus* applies to this shrew as well.

TABLE 2.—*External measurements of* Sorex araneus *from Turkey*

No.	Locality	HBL	Tail	Foot
515	Mereyem Ana	76	54	14
537	Mereyem Ana	77	55	15
542	Mereyem Ana	81	52	15
547	Mereyem Ana	75	49	14
565	Mereyem Ana	77	49	14
582	Mereyem Ana	76	48	—
888	Mereyem Ana	70	52	14
6.3.6.14 (B.M.)	Sumela	67	50	12.5*
6.3.6.15 (B.M.)	Sumela	70	48	13*
6.3.6.16 (B.M.)	Sumela	66	49	13*
6.3.6.17 (B.M.)	Sumela	70	49	13.5*
6.3.6.19 (B.M.)	Sumela	68	52	13*
6.3.6.20 (B.M.)	Sumela	67	52	13.5*
6.3.6.21 (B.M.)	Sumela	72	52	12.5*
6.3.6.25 (B.M.)	Sumela	70	50	14*
6.3.6.212 (B.M.)	Sumela	70	50	14*
6.3.6.213 (B.M.)	Sumela	70	53	13.5*
6.3.6.214 (B.M.)	Sumela	71	51	13.5*
6.3.6.26 (B.M.)	Khotz	70	53	14*
6.3.6.27 (B.M.)	Khotz	77	55	13*
6.3.6.211 (B.M.)	Khotz	80	55	13*
911a	Ulu Dağ	56.5	36.5	13

*Without claw.

Neomys anomalus Cabrera

Sharp-nosed mouse of the water (sivri burunlu su faresi), round tailed water shrew.

This shrew is known to have a discontinuous distribution in Europe (Van den Brink, 1956 and Niethammer, 1953). Records of collections are from a scattering of localities. A sight record from Jerusalem has never been verified (Bodenheimer, 1935, 1958). Miller (1908) reported the collection of a specimen "twenty-five miles north of Erzerum, 7,000 ft., Asia Minor." I collected three specimens in a swampy area along a stream called Rive Çayisi or Irve Deresi near Mahmutşevketpaşa (Ömerli). These specimens indicate that the

distribution of *N. anomalus* previously was continuous between western Anatolia and southeastern Europe (fig. 3).

The external measurements of my specimens and Miller's (1908) are as follows:

collection	*HBL*	*tail*	*foot*
Osborn	87	53	18
Osborn	79	47	17*
Osborn	82	47	17*
Miller	88	58	18.5

*Without claw.

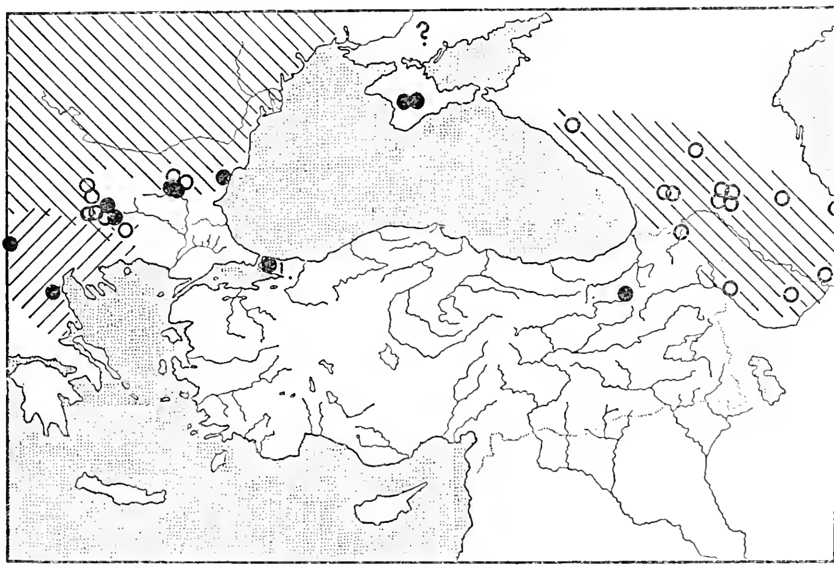

FIGURE 3

Neomys anomalus
probable range
localities of collection
new collection record:
1 Mahmutşevketpaşa (Ömerli)

Neomys fodiens
probable range
localities of collection

After Van den Brink (1956), Bobrinskii et al (1944), Markov (1957), and Niethammer (1953).

Neomys fodiens

This European water shrew has been collected in the Georgian and Armenian SSR near the Turkish border and probably will be found to occur in eastern Antolia (fig. 3).

Crocidura leucodon Hermann

Sharp-nosed mouse of the fields (sivri burunlu tarla faresi), bicolor white-toothed shrew.

This shrew is widely distributed and has been reported from all countries adjacent to Turkey except Syria (fig. 4). Bodenheimer (1958) reported the species *C. lasiura lasia* Thomas 1906=(*C. leucodon*) as being common in Lebanon.

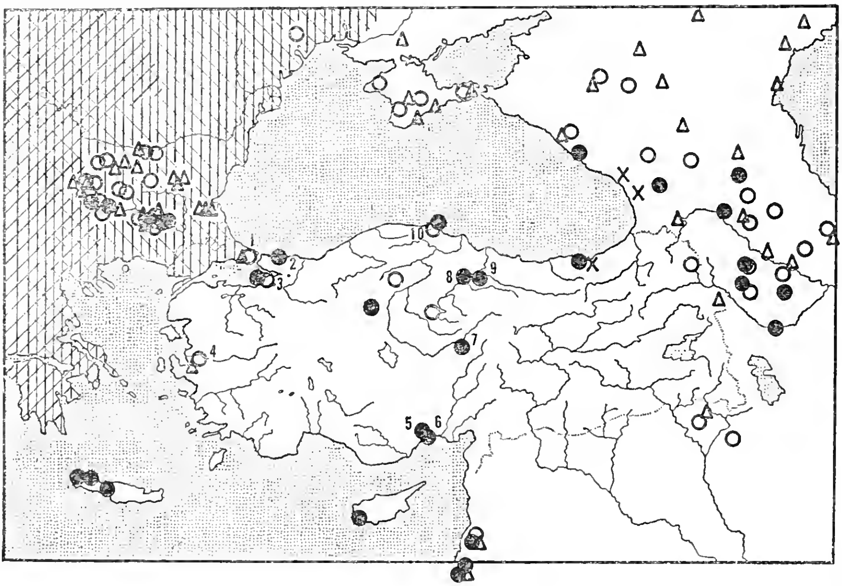

FIGURE 4

Crocidura russula

probable range

localities of collection

new collection records: 2 Şile; 3 Taşköprü, Yalova; 5 Cehennem Dere; 6 Tarsus; 7 Kayseri; 8 Amasya; 9 Borabay Lake, Taşova; 10 Bektaşağa, Sinop

Crocidura lasiura

✕ localities of collection

Crocidura leucodon

probable range

○ localities of collection

new collection records: 1 Istanbul; 3 Taşköprü, Yalova; 10 Bektaşağa, Sinop

Crocidura suaveolens

||| probable range

△ localities of collection

new collection records: 1 Istanbul; 4 Izmir

After Van den Brink (1956), Bobrinskii et al (1944), Hatt (1959), Markov (1957), Bate (1903, 1945), Wettstein (1953), Allen (1915), Harrison (1956), Bodenheimer (1958), and the collections of the British Museum and the Zoological Museum, Munich.

Thomas (1906) first recorded the species from Turkey in the mountains south of Trabzon. There are a few specimens in the British Museum from Changra (Çankiri), Yozgat, and Smyrna (Izmir). I collected two specimens near Bektaşağa, Sinop, and one at Taşköprü, Yalova. Seven from the vicinity of Istanbul represent the first specimen records from Thrace even though Van den Brink (1956) included this area on his map of the range of this species.

In Anatolia, *C. leucodon* was trapped together with *C. russula* along streams under bracken and other dense vegetation and in thick ground litter in hardwood forest. Near Istanbul, *C. leucodon*, along with *C. suaveolens*, was trapped in dense grass under poplar trees.

The characters used by Miller (1912) and Ellerman and Morrison-Scott (1951) to separate *C. leucodon* from *C. russula* can not always be used with satisfaction. Dental characters are useful only when dealing with young animals and an overlap of measurements of the two species is rather marked (tables 3 and 4).

Dr. Henry W. Setzer of the Smithsonian Institution was kind enough to check my material; his notes on the differences between the two species based on a comparison with specimens in the British Museum are:

> *C. leucodon* is markedly whiter on the belly, with the white extending farther up the side. The tail is markedly bicolor in all pelages. There is a pronounced dark streak of color over the tarsus and onto the hallux. The skull is generally flat in the braincase; sides of the skull (braincase) nearly parallel. *C. russula* is pale grayish on the belly, not extending markedly on the sides. Tail not bicolor; no dark colored streak on tarsus or hallux. Skull rather rounded dorsally and sides quite convergent anteriorly. Both *leucodon* and *russula* are of about the same body and cranial size as well as in proportion.

A large series of specimens from Scalita, Trabzon district, in the British Museum were originally said to be *C. leucodon* by Thomas (1906) but were later referred to *C. lasiura* (Ellerman and Morrison-Scott, 1951). The tails of these shrews range from 38–45 millimeters

TABLE 3.—*External and cranial measurements and tail/head and body length ratios of* Crocidura leucodon *from Turkey*

No.	Date	HBL	Tail	Tail/HBL (%)	Foot	Skull			RBr
						Length	Width	Height	
Bektaşağa, Sinop, 1959:									
695	Sept. 8	73	43	59	14	18.4	9.8	5.5	5.9
698	Sept. 8	78	46	59	14	18.7	9.0	5.6	5.7
Taşköprü, Yalova, 1960:									
1092	May 16	84	38	45	14	20.0	9.4	5.9	6.5
Army Sanitorium, Derbent, Istanbul:									
997	Jan. 24	73	35	48	14	19.7	9.5	5.7	6.5
1002	Jan. 28	76	32	42	14	20.4	9.5	5.7	6.7
1003	Jan. 28	70	35	50	14	19.7	9.3	5.6	6.5
1005	Jan. 28	72	34	47	14	19.0	9.3	5.4	6.5
1012	Jan. 29	74	35	47	14	18.9	8.9	5.4	6.3
1019	Jan. 30	80	34	42	14	19.2	9.4	5.7	6.7
1020	Jan. 30	78	(29)	(37)	14	19.5	9.3	5.6	6.4

TABLE 4.—*External and cranial measurements and tail/head and body length ratios of* Crocidura russula *from Turkey*

No.	Date	HBL	Tail	Tail/HBL (%)	Foot	Skull			RBr
						Length	Width	Height	
Tarsus, 1959:									
761	July 20	74	42	56	14	18.3	8.3	5.5	5.7
762	July 20	76	46	61	15	19.8	9.1	5.6	6.1
765	July 21	84	49	58	15	18.8	8.8	5.6	6.2
777	July 23	64	48	75	13	–	8.5	5.2	–
Cehennem Dere, 1959:									
794	July 30	64	45	70	13	18.1	8.5	5.3	5.5
800	July 31	70	45	64	14	19.0	8.8	5.6	5.8
801	July 31	74	46	62	13	18.3	8.7	5.3	5.8
804	Aug. 1	74	45	62	13	18.7	9.0	5.6	5.8
805	Aug. 1	76	46	60	14	18.3	8.8	5.3	5.8
811	Aug. 1	68	50	74	14	19.0	8.6	5.5	5.8
812	Aug. 1	74	47	64	14	18.4	8.5	5.6	5.7
Kayseri, 1959:									
834	Aug. 11	72	43	60	14	18.0	8.5	5.4	5.6
843	Aug. 11	66	46	70	13	17.4	8.5	5.0	5.4
Şile, 1959:									
965	Sept. 26	62	38	61	13	16.4	7.9	4.8	5.2
Mereyem Ana, Trabzon, 1958:									
581	Aug. 1	80	37	46	(13)	20.6	9.5	5.7	6.6
Amasya, 1958:									
596	Aug. 10	65	48	74	14	18.5	8.5	5.4	5.9
Borabay Lake, Taşova, 1958:									
609	Aug. 16	70	45	64	14	18.7	8.9	5.4	5.7
619	Aug. 18	72	43	60	15	18.4	8.8	5.4	6.0
620	Aug. 18	73	39	53	13	18.0	8.7	5.2	5.7
Bektaşağa, Sinop, 1959:									
686	Sept. 6	72	45	62	14	18.1	8.7	5.3	5.7
687	Sept. 6	75	41	55	13	18.9	9.0	5.7	5.5
688	Sept. 6	74	45	61	14	19.0	8.9	5.6	6.0
691	Sept. 6	70	43	60	13	17.7	8.5	5.3	5.7
692	Sept. 6	74	43	58	14	18.6	8.8	5.4	6.0
703	Sept. 8	68	46	68	14	18.7	8.9	5.4	5.9
704	Sept. 8	72	47	65	14	18.9	8.9	5.3	6.0
Taşköprü, Yalova, 1960:									
1090	May 16	75	37	50	13	18.1	8.8	5.6	6.0
1091	May 16	76	41	54	13	18.9	8.7	5.6	6.0

and from 47–56 percent of the head and body length. Specimens of *C. leucodon* from other parts of Turkey (table 3) have tails varying from 32–46 millimeters and 42–59 percent of the head and body length. Vinogradov (1958) questioned the taxonomic status of

C. lasiura from the Black Sea on the basis of the similarity of the genitalia of the named forms which he examined. The localities of these specimens are shown in figure 4.

The distribution of *C. leucodon* (fig. 4) suggests that, prior to the formation of the Bosporus, there was continuous distribution of the species between Anatolia and the Balkans via Thrace.

Crocidura russula Hermann

Sharp-nosed mouse of the house (sivri burunlu ev faresi), European white-toothed shrew, greater white-toothed shrew.

This shrew is widely distributed in Europe and Asia (Bate, 1945; Bobrinskii et al., 1944; Bodenheimer, 1958; Dor, 1947, and Van den Brink, 1956). It is the only species of shrew from the Near East known to exist on an island, being reported from Crete by Bate (1905) and Wettstein (1953). Prior to my collections, *C. russula* was known to occur in Turkey only in the mountains south of Trabzon (Thomas, 1906) and in the vicinity of Ankara (two skins in the Zoological Museum, Munich) (fig. 4; table 4).

Specimens of *C. russula* were trapped in various habitats. One was captured by hand at mid-day on the open beach sand at Şile. A few were trapped in piles of trash from gardens and fields. The specimen from Mereyem Ana was trapped in grass in an abandoned field. Near Cehennem Dere (Hell River) south of Namrun, specimens were trapped among stones in a pine and fir forest, and in a hardwood forest near Bektaşağa, Sinop. Two specimens were taken in a swamp in the steppe 15 kilometers northeast of Kayseri. The majority of specimens, however, came from streambanks, springs, or swamps. The labels on two specimens from Ankara in the Zoological Museum, Munich, read: "collected in house."

My specimen from Sumela (Mereyem Ana) and those in the British Museum from Scalita and Khotz (Çosandere) in the mountains south of Trabzon are very dark and concolor probably as a response to the humid conditions found in the eastern Black Sea region. Other species of mammals such as *Erinaceus europaeus*, *Pityms subterraneus*, and *Clethrionomys glareolus* also are darkest in this part of their range.

Previous records of the distribution of *C. russula* indicated a broad discontinuity between populations of southeastern Europe and central Anatolia. Now, however, with my collections from western Anatolia and the records of Markov (1957) from Bulgaria, there is a good indication that the species probably occurs in Thrace. The species could have migrated from Europe to Anatolia either via Thrace or across the southern Aegean land bridge via Crete.

Crocidura suaveolens Pallas

Lesser white-toothed shrew.

This shrew has been collected in Bulgaria (Markov, 1957), Greece (Miller, 1912), and the USSR north and east of the Black Sea (Bobrinskii et al., 1944). The species is also known from Iran (Goodwin, 1940), Iraq (Harrison, 1956), and Palestine (Thomas, 1920, and Bodenheimer, 1958). Although Van den Brink (1956) indicated that the species occurred in Thrace, my seven specimens are the first to have been recorded from the region. Three specimens from Yalikahve, Izmir, represent their first occurrence in western Anatolia (fig. 4).

TABLE 5.—*External and cranial measurements and tail/head and body length ratios of* Crocidura suaveolens *from Turkey*

No.	Date	HBL	Tail	Tail/HBL (%)	Foot	Skull			RBr
						Length	Width	Height	
Yalikahve, Izmir, 1959:									
711	Jan. 22	68	42	62	13	17.5	8.5	5.3	5.5
716	Jan. 22	77	37	48	12	17.0	8.5	5.2	5.7
719	Jan. 22	64	42	66	13	17.0	8.4	5.0	5.7
Army Sanitorium, Derbent, Istanbul, 1960:									
1004	Jan. 28	67	39	60	14	18.0	8.5	5.1	5.7
1006	Jan. 28	63	37	58	13	17.0	8.4	5.2	5.4
1017	Jan. 30	62	39	63	12	16.7	8.6	5.1	5.6
1018	Jan. 30	64	35	55	12	18.4	8.5	4.9	5.6
Kağithane Dere, Istanbul, 1960:									
1034	Feb. 28	72	37	51	13	17.8	8.6	5.4	5.9
1043	Mar. 21	70	40	57	13	17.3	8.4	5.0	5.7
1044	Mar. 21	70	39	57	13	17.5	8.4	5.1	5.8

Specimens from Yalikahve were trapped in bamboo along the highway; those from the Istanbul area were in dense vegetation along a stream and in grass in a poplar forest.

Locality records in Thrace and Anatolia suggest that there previously was a connection between populations of *C. suaveolens* that have now been separated by the Bosporus (fig. 4).

Specimens and measurements of *C. suaveolens* are listed in table 5.

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SYSTEMATIC SIGNIFICANCE OF BREEDING TUBERCLES IN FISHES OF THE FAMILY PERCIDAE

By Bruce B. Collette[1]

Introduction

Breeding tubercles are epidermal structures that function primarily in facilitating contact between individuals during spawning. Tubercles are used by some fishes to defend their nests and territories or to protect their body and fin surfaces in nest building. Breeding tubercles are present on species of at least 13 different families of fishes in three orders. Except in the Cyprinidae and Catostomidae, their presence either has been ignored or has been mentioned briefly, with little comment on their biological or systematic importance. The purpose of this study is to survey the Percidae for the presence of breeding tubercles and to compare the different tubercle patterns with the present classification of the family. This paper is the fourth in a series on the systematics of the Percidae (see Collette, 1962, 1963; Collette and Yerger, 1962). A review of the occurrence and significance of breeding tubercles in fishes is currently in preparation.

In view of the large number of reports of breeding tubercles in the Cyprinidae and the Catostomidae, it is somewhat surprising that they

[1] Ichthyological Laboratory, Bureau of Commercial Fisheries, U.S. National Museum, Washington, D.C.

have been neglected in the Percidae. Only 13 papers, covering 16 species in 3 genera, report tubercles. I can now triple the number of species and add 2 genera. Jordan's (1877) description of the tubercles on *Percina evides* is the first such record for this family. From 1931 to 1958, tubercles were reported by Vladykov, 1931 (*Zingel streber*); Hubbs and Cannon, 1935 (*Etheostoma serriferum, E. gracile, E. fusiforme*); Bailey, 1948 (*Percina evides, P.* (*Imostoma*) species, *Etheostoma nianguae*); Moore and Cross, 1950 (*Etheostoma cragini*); Moore and Rigney, 1952 (*E. radiosum*); Cross, 1954 (*Percina shumardi, Etheostoma gracile*); Hubbs, 1954 (*Percina shumardi*); Cross and Minckley, 1958 (*Etheostoma stigmaeum*); Winn, 1958b (*E. stigmaeum, E. microperca*). In recent years, tubercles have been reported by Collette, 1962 (the six species of the subgenus *Hololepis*, adding *Etheostoma zoniferum, E. collis, E. saludae* to the three noted by Hubbs and Cannon, 1935); Distler and Metcalf, 1962 (*E. pallididorsum*); and Bailey and Richards, 1963 (*E. hopkinsi*).

Methods.—In order to find tuberculate material, or to ascertain that a given species is not tuberculate, it was necessary to examine large numbers of specimens. Particular attention was paid to collections made during the spring. Specimens were examined under a binocular microscope and compressed air was used to dry the scales and fin-rays to make the tubercles discernible. The presence of tubercles is ephemeral in many species; therefore the fact that I have not recorded them for a given species does not prove that they do not occur. Gonad development was frequently estimated and recorded, especially in cases where tubercles were not found. The descriptions of breeding tubercles of each species are based on the specimens with the best developed tubercles, although, when adequate collections were available, additional specimens were utilized to trace seasonal development. Catalog numbers, locality, and date of collection are given for at least the best tuberculate material examined of each species.

The study is based upon a survey of the percids in the collections of the U.S. National Museum (USNM), Cornell University (CU), University of Michigan Museum of Zoology (UMMZ), and Tulane University (TU), with additional observations on specimens from the Academy of Natural Sciences of Philadelphia (ANSP), Museum of Comparative Zoology (MCZ), University of Kansas (KU), Virginia Polytechnic Institute (VPI), University of Georgia (UG), University of Mississippi (UM), Illinois Natural History Survey (INHS), University of Texas (TNHC), University of Florida (UF), Florida State University (FSU), and Charles University, Prague. I have examined preserved males in breeding condition of at least 100 the approximately

118 species of Percidae. I also examined nonbreeding material of all species except *Stizostedion marinum*.

Tubercle patterns, together with brief comments on other types of sexual dimorphism, are described, species by species, in the following sections. The suprageneric classification used follows that outlined in a recent paper (Collette, 1963), where the Percidae was divided into two subfamilies, the Luciopercinae and the Percinae. Each of these subfamilies was subdivided into two tribes, the Luciopercini and the Romanichthyini in the first subfamily, and the Percini and Etheostomatini in the second. The arrangement of genera, subgenera, and species within the Etheostomatini (table 1) is modified from that presented by Bailey (*in* Bailey and Gosline, 1955).

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Tribe Luciopercini

Genus *Stizostedion* Rafinesque

There is little sexual dimorphism in the five species of *Stizostedion*—*canadense* (Smith), *lucioperca* (Linnaeus), *marinum* (Linnaeus), *vitreum* (Mitchill), and *volgense* (Gmelin)—and breeding tubercles are apparently absent. Females of all species reach a larger maximum size than the males and on the average are longer and heavier in a given year class, at least after the first two years of life. For *S. canadense*, see Carlander (1950); for *S. vitreum* see Eschmeyer (1950), Hile (1954)

Table 1.—*Distribution of breeding tubercles in the fishes of the family Percidae* (+ = present; 0 = absent; ? = material not adequate; ♂ and ♀ are placed under areas where tubercles were found: TP? = tubercles present?; Bd = body; A = anal fin; P_2 = pelvic fins; C = caudal fin; Hd = head; Ch = chin; P_1 = pectoral fins; D = dorsal fins; Br = branchiostegals)

Taxon	TP?	Bd	A	P_2	C	Hd	Ch	P_1	D	Br
Luciopercini										
Stizostedion	0	–	–	–	–	–	–	–	–	–
Romanichthyini										
Zingel										
asper	+?	–	–	–	–	–	–	–	–	–
streber	+	♂♀	–	–	–	♂♀	–	♂♀	–	–
zingel	+	♂♀	–	–	–	♂♀	–	♂♀	♂	–
Romanichthys										
valsanicola	+	♂♀	♂	♂♀	♂♀	♂	–	♂♀	♂	–
Percini										
Perca	0	–	–	–	–	–	–	–	–	–
Gymnocephalus	0	–	–	–	–	–	–	–	–	–
Percarina	0?	–	–	–	–	–	–	–	–	–
Etheostomatini										
Percina										
(*Hypohomus*)	0	–	–	–	–	–	–	–	–	–
(*Alvordius*)	0	–	–	–	–	–	–	–	–	–
(*Hadropterus*)	0	–	–	–	–	–	–	–	–	–
(*Swainia*)	0	–	–	–	–	–	–	–	–	–
(*Percina*)										
caprodes	+	♂	–	–	–	–	–	–	–	–
rex	+	♂	–	–	–	–	–	–	–	–
(*Ericosma*)										
palmaris	0	–	–	–	–	–	–	–	–	–
crassa	0	–	–	–	–	–	–	–	–	–
evides	+	♂	♂	♂	♂	♂	♂	–	–	♂
(*Imostoma*)										
shumardi	+	♂	♂	♂	♂	♂	–	–	–	–
uranidea	+	♂	♂	♂	♂	♂	–	♂	–	–
(*Cottogaster*)	0	–	–	–	–	–	–	–	–	–
Ammocrypta										
(*Crystallaria*)										
asprella	+	–	♂	♂	–	–	–	–	–	–
(*Ammocrypta*)										
vivax	+	–	♂	♂	–	–	–	–	–	–
pellucida	+	–	–	♂	–	–	–	–	–	–
clara	+	–	♂	♂	♂	–	–	–	–	–
beanii	+	–	♂	♂	–	–	–	–	–	–
Etheostoma										
(*Boleosoma*)										
nigrum	0	–	–	–	–	–	–	–	–	–
olmstedi	0	–	–	–	–	–	–	–	–	–
perlongum	0	–	–	–	–	–	–	–	–	–
longimaEum	0	–	–	–	–	–	–	–	–	–
podostemone	0	–	–	–	–	–	–	–	–	–
chlorosomum	+	–	♂	♂	–	–	–	–	–	–
stigmaeum	+	♂	♂	♂	–	–	–	–	–	–
jessiae	+	♂	♂	♂	–	–	–	–	–	–
(*Ioa*)	0	–	–	–	–	–	–	–	–	–
(*Etheostoma*)										
variatum	+	♂♀	–	–	–	–	–	–	–	–
tetrazonum	+	♂♀	–	–	–	–	–	–	–	–
euzonum	+	♂♀	–	–	–	–	–	–	–	–

TABLE 1.—Continued

Taxon	TP?	Bd	A	P_2	C	Hd	Ch	P_1	D	Br
Etheostomatini—Continued										
Etheostoma—Continued										
(*Etheostoma*)—Continued										
kanawhae	+	♂ ♀	–	–	–	–	–	–	–	–
osburni	+	♂ ♀	–	–	–	–	–	–	–	–
inscriptum	+	♂	–	–	–	–	–	–	–	–
thalassinum	+	♂	–	–	–	–	–	–	–	–
swannanoa	+	♂	–	–	–	–	–	–	–	–
blennioides	+	♂	–	–	–	–	–	–	–	–
gutselli	+	♂	–	–	–	–	–	–	–	–
blennius	0?	–	–	–	–	–	–	–	–	–
sellare	0?	–	–	–	–	–	–	–	–	–
rupestre	0	–	–	–	–	–	–	–	–	–
histrio	0	–	–	–	–	–	–	–	–	–
zonale	0	–	–	–	–	–	–	–	–	–
(*Ulocentra*)	0	–	–	–	–	–	–	–	–	–
(*Allohistium*)	0	–	–	–	–	–	–	–	–	–
(*Nothonotus*)	0	–	–	–	–	–	–	–	–	–
(*Oligocephalus*)										
nianguae	+	♂	–	–	–	–	–	–	–	–
sagitta	+	♂	–	–	–	–	–	–	–	–
radiosum	+	♂	–	–	–	–	–	–	–	–
whipplii	+	♂	–	–	–	–	–	–	–	–
caeruleum	+	♂	–	–	–	–	–	–	–	–
punctulatum	+	♂	♂	♂	♂	–	–	–	–	–
parvipinne	+	–	♂	–	–	–	–	–	–	–
fricksium	+	–	♂	–	–	–	–	–	–	–
hopkinsi	+	♂	♂	♂	–	–	–	–	–	–
spectabile	+	♂	♂	♂	♂	–	–	♂	–	–
lutcovinctum	+	♂	♂	♂	♂	–	–	–	–	–
cragini	+	♂	♂	♂	–	–	–	–	–	–
pallididorsum	+	♂	♂	♂	–	–	–	–	–	–
asprigene	0	–	–	–	–	–	–	–	–	–
swaini	0	–	–	–	–	–	–	–	–	–
mariae	0	–	–	–	–	–	–	–	–	–
juliae	0	–	–	–	–	–	–	–	–	–
pottsii	0	–	–	–	–	–	–	–	–	–
lepidum	0	–	–	–	–	–	–	–	–	–
exile	0	–	–	–	–	–	–	–	–	–
grahami	0	–	–	–	–	–	–	–	–	–
(*Villora*)	0	–	–	–	–	–	–	–	–	–
(*Austroperca*)	?	–	–	–	–	–	–	–	–	–
(*Psychromaster*)	0	–	–	–	–	–	–	–	–	–
(*Catonotus*)	0	–	–	–	–	–	–	–	–	–
(*Hololepis*)										
serriferum	+	–	♂	♂	–	–	–	–	–	–
gracile	+	–	♂	♂	–	–	♂	–	–	–
zoniferum	+	–	♂	♂	–	–	♂	–	–	–
fusiforme	+	–	♂	♂	–	–	–	–	–	–
saludae	+	–	♂	♂	–	–	–	–	–	–
collis	+	–	♂	♂	–	–	–	–	–	–
(*Microperca*)										
proeliare	+	–	♂	♂	–	–	–	–	–	–
microperca	+	–	♂	♂	–	–	–	–	–	–
fonticola	+	–	♂	♂	–	–	–	–	–	–

and Rawson (1957); and for the three European species, see data presented by Berg (1949). Vladykov (1931) and Oliva (1953) reported that males of *S. lucioperca* have relatively longer fins than the females. Vladykov (1931) noted the same for *S. volgense.*

Tribe Romanichthyini

Genus *Zingel* Cloquet

There are three species in this genus: *asper* (Linnaeus), *streber* (Siebold), and *zingel* (Linnaeus). Both sexes of *Z. streber* and *Z. zingel* are tuberculate; *Z. asper* also will probably be found to be so.

I have examined 10 tuberculate males of *Zingel streber* (ANSP 82497, Rumania, Mures R., 108 mm.; USNM 187742, Rumania, Criscul R., 57–108 mm.; and USNM 190212, Rumania, Timis R., 98–99 mm.), all collected in October, and 9 tuberculate females from the same collections, plus USNM 187740 (Criscul R., April, 131 mm.). In the male, where they are best developed (USNM 190212, 99 mm.), tubercles are present on all the head scales including those on the opercle and preopercle. These tubercles are elongated longitudinally with the point of the tubercle projecting upward and posteriorly beyond the margin of the scale. A few head scales have two tubercles per scale, but the majority only have one. Prominent ridgelike tubercles are developed on all the body scales above the lateral line posterior as far as the middle of the caudal peduncle. They are also present on several rows of scales below the lateral line in the region posterior to the tip of the pectoral fin. The females and the other males have a similar pattern of tubercle development, but the tubercles are more ridgelike and less prominent and are not on as many scales. The individual tubercles are aligned in the same direction from one scale to the next, creating continuous ridges along the body. Among the Percidae, this condition is unique in the genus *Zingel.* None of the tuberculate specimens show any sign of tubercles on any of the fins. Rudolph J. Miller examined a 150 mm. gravid tuberculate female of *Z. streber* (Charles University No. 9908, Czechoslovakia, Orawa R., April 4) and he corroborates what I have found, although the tubercles seem to have been somewhat better developed than in the females I examined. Vladykov (1931) reported that *Zingel streber* had tubercles on the pectoral fins as well as on the head and the body.

I have examined one tuberculate specimen of *Zingel zingel*, a 175 mm. male that Dr. Miller found for me (Charles University no. 4514, Czechoslovakia, Danube R., May 5). There are tubercles on all the head scales and on the dorsal and dorsolateral body scales. These tubercles are only slightly raised and do not form longitudinal rows as they do in *Z. streber.* There are tubercles on the anterior ten rays in

the second dorsal fin and on the anterior surface of the upper pectoral rays. None are present on the first dorsal, anal, or pelvic fins. Two other males with greatly enlarged testes (MCZ 3063) and 7 egg-filled females (USNM, MCZ, ANSP) lack tubercles. Dr. Miller also examined a large female *Z. zingel* in the Charles University collection which had poorly developed tubercles on the head scales, scales of the anterior dorsum, and on the pectoral rays. Vladykov (1931) reported that sexual dimorphism was rather marked in this species, but only mentioned that the paired fins of the males were much longer than those of the females.

I examined one male of *Zingel asper* with well-developed testes (ANSP 14055, France, Rhone R., 116 mm.) and one female filled with large eggs (MCZ 2551, Saone R., 105 mm.). Neither had any breeding tubercles. Both specimens, however, were in poor condition, and *Z. asper* will probably be found to have a tubercle distribution very similar to that of its close relative *Z. streber*.

Genus *Romanichthys* Dumitrescu, Bănărescu, and Stoica

I have examined four tuberculate males of the only species in this genus, *Romanichthys valsanicola* Dumitrescu, Bănărescu, and Stoica (USNM 190149, Arges R., May 22, 66 mm.; USNM 187749, Arges R., May–June, 68 mm.; MCZ 40966, Vilsan R., June–Aug., 85 mm.; and UMMZ uncat., Arges R., June–July, 76 mm.) and two tuberculate

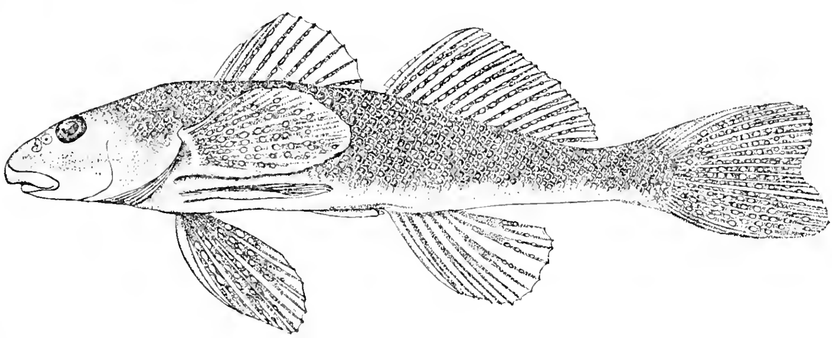

Figure 1.—Male of *Romanichthys valsanicola* showing the distribution of breeding tubercles (USNM 190149, Rumania, Arges River, May 22, 66 mm. SL).

females (MCZ 40966, 86 mm. and UMMZ uncat., 69 mm.). Another male (USNM 190180, 92 mm., June–Aug.) has well-developed testes but lacks tubercles. Four females (USNM 190149, 96 mm.; MCZ 40966, 80 and 89 mm.; and UMMZ uncat., Vilsan R., Oct. 19, 65 mm.) also lack tubercles. The tubercles are best developed in the smaller USNM male (fig. 1). There are a few small tubercles distally on the dorsal surface of pelvic soft rays 2–5 and ventrally on rays 3–5.

Tubercles are present along the outside of the pectoral fin on the upper 10–11 rays and on the inside on the lower 2–6 rays. The tubercles on the outer surface are longer and relatively low; those on the inner surface are smaller and more conical. Tubercles are present on the upper principal caudal rays, on the dorsal 3–4 rays of the lower half of the caudal fin, and on the last three anal soft rays. Tubercles are developed distally on all but the first two dorsal spines and on the entire length of the second dorsal rays. This is the only percid with tubercles on both dorsal fins. A low conical tubercle is present in the center of most of the exposed body scales, although the tubercles are smaller on the ventral side of the caudal peduncle. Tubercles also are present on the dorsal half of the opercle. In many ways, the overall appearance of the body tubercles on this specimen is reminiscent of the tubercle pattern of the minnow *Campostoma anomalum* (see color plate, Forbes and Richardson, 1909). One tuberculate female of *R. valsanicola* (MCZ 40966) has small tubercles on many of the body scales, the distal parts of the pectoral rays, the distal tip of pelvic soft ray 4 (dorsal surface), and a few scattered tubercles on the upper caudal fin rays. Another (UMMZ uncat.) has only a few poorly developed tubercles on the pectoral rays. In the lengthy original description of this genus and species (Dumitrescu, Bănărescu, and Stoica, 1957) there was no mention of breeding tubercles.

Tribe Percini

Genus *Perca* Linnaeus

There is little sexual dimorphism in the three species of *Perca: flavescens* (Mitchill), *fluviatilis* Linnaeus, and *schrenki* Kessler. I have found no indication of breeding tubercles in sexually mature specimens of *P. flavescens* or P. *fluviatilis*. There are no tubercles on the single available male of *P. schrenki* (USNM 55712), which has greatly enlarged testes. In *P. flavescens* of corresponding age, the modal and average lengths of females exceed those of males (Hile and Jobes, 1942; Beckman, 1949; Jobes, 1952). Females of *P. fluviatilis* likewise are larger than males (Berg, 1949; Alm, 1952). Vladykov (1931) and Oliva (1953) found that the paired fins of *P. fluviatilis* are longer in males than in females.

Genus *Gymnocephalus* Bloch

There is sexual dimorphism in *Gymnocephalus*. Males of *G. cernua* (Linnaeus) and *G. schraetser* (Linnaeus) are smaller than females (Vladykov, 1931; Oliva, 1953) and the paired fins of the males are somewhat longer. There are no tubercles on nine males of

Gymnocephalus cernua (USNM, UMMZ; 60–87 mm.) with greatly enlarged testes or on 20 egg-filled females (68–158 mm.) from these and nine other USNM collections. Tubercles are absent from five males of *G. schraetser* (ANSP, UMMZ, USNM; 92–117 mm.) with greatly enlarged testes and from nine egg-filled females (105–155 mm.). Smitt (1892, p. 42) reported that there was little external distinction between males and females of *Gymnocephalus acerina* (Güldenstädt). He found that males had longer pelvic fins and deeper bodies than females, but he did not mention breeding tubercles. The one specimen available to me (USNM 28564) is an egg-filled female lacking tubercles.

Genus *Percarina* Nordmann

I have examined three specimens of *Percarina demidoffi* Nordmann (USNM 37308 and MCZ 26527). All are females filled with eggs. All lack tubercles.

Tribe Etheostomatini

The darter tribe is the most speciose in the family, with 102 valid described species, plus about a dozen undescribed ones. Bailey (*in* Bailey, Winn, and Smith, 1954; and *in* Bailey and Gosline, 1955) has recently reduced the nominal genera of darters to three: *Percina* (22 species in 8 subgenera), *Ammocrypta* (5 species in two subgenera), and *Etheostoma* (76 species in 13 subgenera). Several changes within subgenera, based on tubercle patterns, seem necessary, especially in the subgenera *Ericosma, Boleosoma, Ioa, Etheostoma,* and *Oligocephalus.* I hesitate to make nomenclatorial changes based primarily on breeding tubercle patterns, and in this paper I shall merely discuss some of the groups in which reallocation seems desirable.

Genus *Percina*

Subgenus *Hypohomus* Cope

This subgenus contains three species: *aurantiaca* (Cope), *cymatotaenia* (Gilbert and Meek), and one undescribed species. Males apparently lack breeding tubercles, although a unique adaptation probably performs the same function. Bailey (1948) pointed out that males of *Hypohomus* have a thin flangelike midventral keel on the lower edge of the caudal peduncle near the caudal base bearing strongly developed ctenoid scales. This seems especially significant, because males of the subgenus *Hypohomus* have the fewest enlarged midventral scales of any of the subgenera of *Percina.* It will be interesting to see how these keels function in spawning.

Males of *P. aurantiaca* in 7 collections (UMMZ, USNM), taken from April 19 through October 3, lack tubercles. One of these specimens, a 132 mm. male taken April 29 (UMMZ 129572, Tennessee, Little Pigeon R.), has greatly enlarged testes and appears to be near spawning condition. No males of *P. cymatotaenia* collected in the spring were examined, but a 69 mm. male taken on August 26 (UMMZ 152290, Mo., Gasconade R.) has slightly enlarged testes and a well-developed caudal keel. The ventral scales of this specimen have well developed ctenii, making the venter very rough to the touch. The best-developed caudal keels I have observed were pointed out to me by Reeve M. Bailey and are in three males of the undescribed species of *Hypohomus* (UMMZ 165304, Kentucky, Green R., April 5, 50–65 mm.). They are covered with ctenoid scales resembling the modified midventral scales usually present in males of *Percina*. The anal fin of these males, considerably longer than that of the two females in the same collection, reaches to the base of the caudal, thus connecting it with the caudal keel and apparently forming a single functional unit.

Subgenus *Alvordius* Girard

There are five species in this subgenus: *macrocephala* (Cope), *maculata* (Girard), *notogramma* (Raney and Hubbs), *pantherina* (Moore and Reeves), and *peltata* (Stauffer). I have examined adequate breeding material of the last four species and have found no tubercles. Males have enlarged midventral scales and considerably more pigment in the first dorsal fin than the females have. Both sexes of *P. maculata* are equal in size. The males lack breeding tubercles, but the genital papillae of the females are elongate, broad, and tubelike (Winn, 1958b, p. 172). Petravicz (1938) did not mention breeding tubercles in this species. *P. maculata* spawns over sand or gravel, with the male mounted on the female's back (Winn, 1958b, fig. 4). *P. peltata* spawns in a similar manner, but the male's caudal peduncle does not lie alongside the female's, as is the case of most darters. The enlarged caducus scales on the male belly apparently serve both to stimulate the female and to enable the male to maintain his position over her (New, 1963; and pers. comm.).

Subgenus *Hadropterus* Agassiz

There are three described species in this subgenus: *nigrofasciata* (Agassiz), *sciera* (Swain), and *lenticula* Richards and Knapp. There are no tubercles on specimens taken in six March–April collections of *P. nigrofasciata* from Georgia, Alabama, and Mississippi. The ovaries and testes of these specimens are greatly enlarged, indicating

that they are close to spawning condition. Several of the males are extremely darkly pigmented. Crawford (1956) thus describes sexual dimorphism in *P. n. nigrofasciata:* The males are larger and darker than females; the vertical bars of the males tend to be more discrete and less confluent; enlarged ctenoid scales are present along the midventral line on the males' bellies; and the genital papillae in the females are long, conical, and clearly villiform.

No tubercles are present on specimens of *P. sciera* in three Oklahoma–Texas collections taken in March and April. The testes and ovaries of all these specimens are greatly enlarged. The vertical banding present in the females becomes completely obscured by the dark pigment in breeding males. The fins, belly, and breast are almost black in these males. Males have enlarged scales along the midventral line of their bellies.

There are no tubercles on the two males of the recently described *P. lenticula* collected in the spring (CU 43592, Alabama drainage, May 9, 96 mm., holotype; CU 43594, Alabama drainage, May 17, 86 mm., paratype). There is little sexual dimorphism in color pattern (Richards and Knapp, 1963).

Subgenus *Swainia* Jordan and Evermann

There are four species in this subgenus: *nasuta* (Bailey), *oxyrhyncha* (Hubbs and Raney), *phoxocephala* (Nelson), and *squamata* (Gilbert and Swain). I have examined 15 collections of *P. phoxocephala* taken from mid-March to September (UMMZ, USNM, KU), a male of *oxyrhyncha* taken on June 25 (UMMZ 118422, holotype), a male of *squamata* taken on May 25 (UMMZ 177816), and 5 males of *nasuta* taken on April 26 (CU 41971), and have found no tubercles. Trautman (1957, p. 543) reported that breeding males of *P. phoxocephala* are more intensely colored than females and have orange bands on the first dorsal fin.

Subgenus *Percina* Haldeman

There are two species in this subgenus: *caprodes* (Rafinesque), with several subspecies, and *rex* (Jordan and Evermann). Tubercles are present on the ventral scale rows of the males of both species. Tubercles seem to be better developed and present for a longer period in southern populations, *Percina caprodes carbonaria* (Baird and Girard), than in northern ones. Both species have low rounded tubercles on the posterior part of the scales. The tubercles are usually not prominent, so that magnification and drying are necessary to trace their extent. No fin tubercles were found, and the females lack tubercles altogether.

Specimens with tubercles of *P. caprodes carbonaria* have been found in five collections, dating from April 14 (CU 32822, Missouri, Lamine R.) to May 18 (TU 15493, Arkansas, Arkansas R.). Tubercles were found on males of *P. c. caprodes* × *P. c. semifasciata* (DeKay) intergrades taken April 20 (CU 8238, Pennsylvania, Shenango R., 88–110 mm. standard length). A male *P. caprodes* with well-developed tubercles (TU 15493, 102 mm.) had tubercles on the modified midventral scales, 5 rows on each side of the modified midventral row, 8 rows per side just anterior to the genital papilla, 4 rows along each side of the anal fin base, and 11 ventral caudal peduncle rows. The pelvic and anal fins and the venter of females lack pigment; these areas are darkened in males. Winn (1958b, p. 172) reported that both sexes of Michigan *P. caprodes* were of equal size, that the anal fins of males were larger than those of females, and that breeding tubercles were absent.

In spawning, the female *P. caprodes* stops over sand or gravel ahead of a male. The male swims up and mounts her with his pelvic fins over her relaxed first dorsal fin and his tuberculate lower sides in contact with her sides (Reighard, 1913; Winn, 1958a; 1958b, fig. 4). Sometimes accessory males vibrate with the spawning pair (Winn, 1958a).

One tuberculate male of *Percina rex* was examined (CU 16910, Virginia, Roanoke R., March 27, 105 mm.). It has tubercles on 2–3 rows of scales on each side of the midventral row and on the posterior ventral portion of the caudal peduncle. A female and a smaller male from this collection lack tubercles.

Subgenus *Ericosma* Jordan and Copeland

Three species are presently placed in this subgenus: *evides* (Jordan and Copeland), *crassa* (Jordan and Brayton), and *palmaris* (Bailey). The two latter species apparently lack tubercles, but males of *P. evides* have well-developed tubercles on numerous parts of the body (fig. 2). Jordan's (1877) discovery of tubercles on the pelvic and anal fins of *P. evides* was the first record of tubercles in the Percidae. Bailey (1948) also noted tubercles on the lower fins of this species.

Tubercles are present on males of *P. evides* in several collections taken from March 10 (UMMZ 103459, Tennessee, Clinch R.) to June 29 (UMMZ 131458, North Carolina, Swain Co.). Tubercles are present on the ventral surfaces of all pelvic soft rays (but apparently are absent from the spine), dorsally on the distal parts of pelvic soft rays 1–3, and laterally on the anal spines and soft rays. The tubercles are quite small and conical and, lacking pigment, stand out in contrast to the darkly pigmented fins. In males with

maximum tubercle development (CU 38055 and CU 38127, Georgia, Toccoa R., June 7) tubercles are present on most ventral scale rows posterior to the pelvic fins and below the lateral line. A few tubercles are present on some of the lateral line scales. The modified midventral scales have up to three tubercles per scale. This, with *P. uranidea* and *P. caprodes*, is one of the few darters in which tubercles are present on these scales and is the only species in which there is more than one tubercle per scale. If the midventral scales function in a manner analagous to the breeding tubercles, the possession of both tubercles and the modified scales seems unnecessary. It will

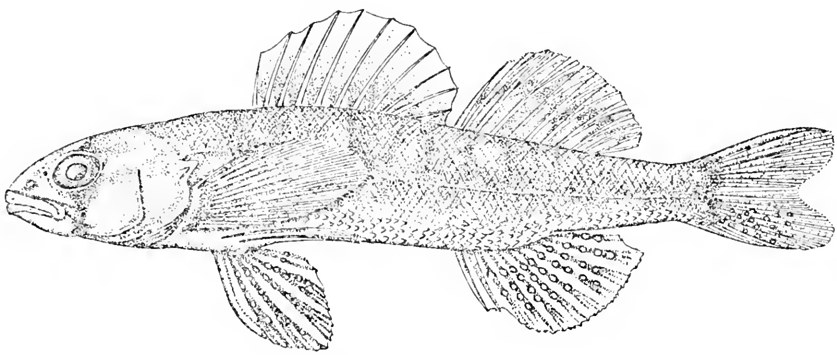

FIGURE 2.—Male of *Percina* (*Ericosma*) *evides* showing the distribution of breeding tubercles (USNM 44433, Indiana, Tippecanoe River, May 16, 53 mm. SL).

be interesting to learn how these structures function in the courtship-spawning act. Tubercles are present on some rays of the ventral half of the caudal fin. The cephalic pores of the preoperculomandibular and infraorbital canals are sites for small tubercles. These tubercles extend onto the chin beside the pores of the anterior portion of the preoperculomandibular canal, as in *Etheostoma* (*Hololepis*) *gracile* and *E.* (*H.*) *zoniferum*. Tubercles are present on some of the branchiostegal rays, a condition unique among the Percidae, although known for some Cyprinidae. Small scattered tubercles are present on parts of the opercle.

Among the Percinae, only *Percina* (*Imostoma*) *uranidea* has a tubercle distribution which approaches that of *P. evides*. *Romanichthys* and *Zingel* in the Luciopercinae have large numbers of tubercles on the head, concentrated on top.

Tubercles are absent on specimens of *P. crassa* in several March and April collections (UMMZ), although the males have greatly enlarged testes and the females are filled with large eggs. Eight males of *P. palmaris* taken on March 31 (CU 17328, Georgia, Talking Rock Cr.) appear to be in full breeding color, but they lack breeding tubercles, although fleshy ridges similar to those in *Etheostoma*

(*Oligocephalus*) *nianguae* are well developed on the anal elements and, to a lesser degree, on the ventral surfaces of the pelvic rays. Lack of tubercles may indicate that these two species are not as closely related to *P. evides* as was indicated by Bailey (1940; and *in* Bailey and Gosline, 1955).

Subgenus *Imostoma* Jordan

There are two species in this subgenus: *shumardi* (Girard) and *uranidea* (Jordan and Gilbert). Males of both species have tubercles on many areas and have the anal fin greatly elongated so that it reaches to the caudal base. Bailey (1948) reported tubercles on the lower fins of "the several species" of *Imostoma*.

Tubercles are present on males of *P. shumardi* taken from January 12 (TU 14902, Mississippi, Pearl R.) to July 7 (USNM 44432, Indiana, Wabash R.). At maximum development (USNM 187775, Texas, Guadalupe R., Feb. 4, 47–56 mm.; UMMZ 81563, Michigan, Au Sable R., April 30, 38–45 mm.; and KU 3208, Kansas, Neosho R., April 10, 49–51 mm.) large high tubercles are present on the entire length of the anal soft rays. Small tubercles are present on the second anal spine. Tubercles are present on the entire length of the ventral surface of pelvic soft rays 1–2 or 2–3 and on the distal tip of rays 3–4. Tubercles cover the entire length of the most ventral five principal rays of the caudal fin and a few are found on the distal tips of the next two rays. Cross (1954) reported tubercles on the anal and caudal fins of the KU specimens. In a 55 mm. male from USNM 187775, a small tubercle is also present on the posterior portion of each of the midventral scales, in addition to a few tubercles above the upper jaw next to the openings of the infraorbital canal and a few scattered tubercles on the posterior portions of the preopercle and opercle. Tubercles are better developed on larger males as shown by TU 14902, in which three males, 59–67 mm. long, lack tubercles and three males, 62–70 mm., have well-developed tubercles. Hubbs (1954) has noted elongate tubercles on the anal rays of mature males.

P. uranidea is even more tuberculate than *P. shumardi*, and is exceeded in the Percidae only by *Romanichthys valsanicola* and *P.* (*Ericosma*) *evides*. At maximum tubercle development, males have tubercles on almost all surfaces of the ventral half of the body (fig. 3). The tubercles on the anal fin closely resemble those on *P. shumardi* and are found at maximum development on the distal half to three-fourths of all anal soft rays. Similar tubercles are present on the ventral surface of all the elements of the pelvic fin, but they are larger and better developed on the soft rays than on the spine. Although they are also present on the dorsal surface, they are less numerous

and tend to be confined to the distal portion of the soft rays. Tubercles sometimes are developed on the few imbedded breast scales, the modified midventral scales, many of the scale rows lateral to the midventral rows, and on the ventral rows of caudal peduncle scales. As in *P. shumardi* and *P. evides*, small tubercles develop near the pores

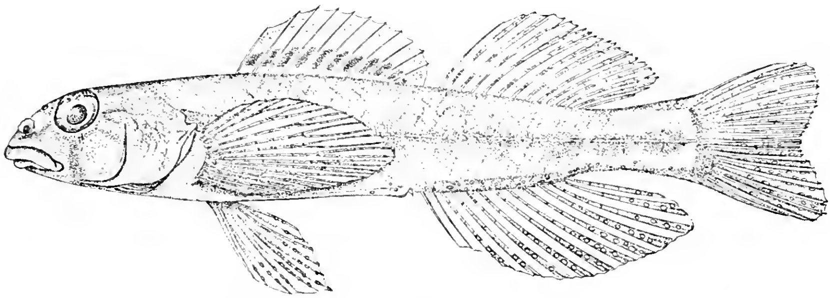

FIGURE 3.—Male of *Percina* (*Imostoma*) *uranidea* showing the distribution of breeding tubercles (TU 7965, Louisiana, Pearl River, Feb. 16, 50 mm. SL).

of the infraorbital and preoperculomandibular canals. Small tubercles are present along some of the rays of the ventral half of the caudal fin. A few specimens have tubercles developed on the ventral 2–5 rays of the pectoral fin, a condition found only in one other species of the Etheostomatini, *Etheostoma* (*Oligocephalus*) *spectabile*.

The abundant material of *P. uranidea* in the Tulane University collections taken throughout the year from Pearl River makes a study of the annual development of the breeding tubercles possible. Maximum development occurs from February 8–16 (table 2), when the peak of spawning most likely occurs.

TABLE 2.—*Development of breeding tubercles in males of* Percina (Imostoma) uranidea *from the Pearl River* (see table 1 for abbreviations; L. Caud.=lower caudal fin)

Dates	Tubercle distribution					
	A	P_2	L. caud.	Bd	P_1	Hd
November 3	–	–	–	–	–	–
December 8	+	+	–	–	–	–
January 28	+	+	–	–	–	–
February 3	+	+	+	–	–	–
February 8–16	+	+	+	+	+	+
March 9	+	+	+	+	–	–
March 28	+	+	+	–	–	–
April 3	+	+	–	–	–	–
April 10	+	+	–	–	–	–
May 8	–	–	–	–	–	–
May 23	–	–	–	–	–	–

Subgenus *Cottogaster* Putnam

P. copelandi (Jordan) is the only known species. I have examined three large collections (USNM) from June, July, and August, an April collection from Pearl River (TU 17732), and several additional collections taken from February through July (UMMZ), and have found no tubercles. The ovaries and testes of these specimens are greatly enlarged. Males have melanophores concentrated in the center of each of the membranes of the first dorsal fin; they have much darker pelvic fins and somewhat darker second dorsal and anal fins, belly, and breast, than the females. Males have 5–12 enlarged mid-ventral scales. Winn (1953, 1958b) reported that males were larger and more heavily pigmented than females, had larger anal fins, and lacked breeding tubercles. The genital papilla of the breeding female is elongate and tubelike. *P. copelandi* spawns over gravel with the male mounted on the female's back (Winn, 1953; 1958b, fig. 4).

Genus *Ammocrypta* Jordan

This genus contains two subgenera: *Crystallaria* Jordan and Gilbert, with a single species, *asprella* (Jordan), and *Ammocrypta* Jordan, with four species, *vivax* Hay, *pellucida* (Agassiz), *clara* (Jordan and Meek), and *beanii* Jordan. Males of all five species probably will be found to have tubercles on the rays of the anal and pelvic fins, confirming the synonymizing of *Crystallaria* under *Ammocrypta* on the basis of tubercle distribution.

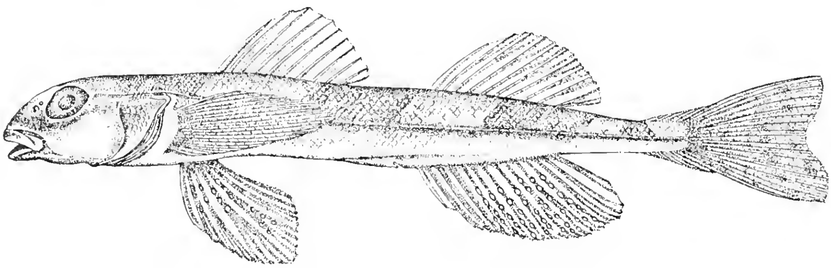

FIGURE 4.—Male of *Ammocrypta* (*Crystallaria*) *asprella* showing the distribution of breeding tubercles (USNM 172363, Louisiana, Ouachita River, Jan. 28, 75 mm. SL).

Tubercles on *A. asprella* begin to develop by late November (TU 1851, Mississippi, Pearl R.), when they are noticeable on the anal spine and the first nine anal soft rays. The maximum development (fig. 4) I have found occurs in the latter half of January (TU 7536, 14921, 15174; Mississippi, Pearl R.; USNM 172363, Louisiana, Ouachita R.). Large conical tubercles are developed on the spine and all the anal soft rays except the last 1–3. In these specimens tubercles are present only on the ventral surface of pelvic soft rays

3–5, but they may be found on the other pelvic fin elements when more material (probably February specimens) is examined.

Males of *A. beanii* develop tubercles on the ventral surface of the pelvic spine and on soft rays 1–4 by March 9 (TU 3843, Louisiana, Pearl R.). By April 26 (TU 19992, Mississippi, Homochitto R.), much larger tubercles are present on the ventral surface of all the pelvic elements and on the distal eighth to two-thirds of all the anal soft rays, but not on the anal spine. A few tubercles are present distally on the dorsal surface of pelvic soft rays 1–3. A male taken on August 17 (TU 24061, Florida, Yellow R.) also has this tubercle distribution, but the tubercles are smaller.

Breeding tubercles are present on males of *A. clara* from as early as June 20 (UMMZ 127887, Arkansas, Saline R., 32–35 mm.) until July 28 (UMMZ 148570, Missouri, Salt R., 38–43 mm.). At the maximum development I have seen (UMMZ 148570), small tubercles are present on the entire length of the ventral surface of the pelvic spine and soft rays. Similar tubercles are present on the distal half to three-fourths of the anal soft rays, but none are developed on the spine. The ventralmost two primary caudal rays have tubercles.

A tubercle distribution similar to that of *A. beanii* was found on males of *A. vivax* taken May 13 (USNM 172539, Louisiana, Red R.) and July 29 (USNM 172557, Louisiana, Red R.).

Tubercles were present on the pelvic rays of males of *A. pellucida* in three collections (UMMZ 100864, Indiana, Salomonie R., May 31; UMMZ 107758, Ohio, Salt Cr., June 8; CU 32967, Ohio, Big Darby Cr., Aug. 22). Additional material will probably show the presence of tubercles on the anal fin also.

Genus *Etheostoma*

Subgenus *Boleosoma* DeKay

This subgenus can be divided into two or three species groups. The *nigrum* group includes five species: *nigrum* Rafinesque, *longimanum* Jordan, *olmstedi* Storer, *perlongum* (Hubbs and Raney), and *podostemone* Jordan and Jenkins. Breeding tubercles do not develop in these species, the tips of the pelvic spines become swollen during the breeding season, and the males have only brown and black pigmentation. These species have a complex spawning behavior under rocks. The second group is comprised of two closely related species: *E. stigmaeum* (Jordan) and *E. jessiae* (Jordan and Brayton). Males of both of these species develop breeding tubercles on the pelvic and anal fins. In addition, they also have tubercles on the ventral scale rows as in the *E.* (*Etheostoma*) *variatum* species group. Males are brightly colored during the breeding season. *E. stigmaeum*

spawns with the male mounted on the female's back like most darters. The third group includes *E. chlorosomum* (Hay), males of which have tubercles on the pelvic and anal fin rays only. Thus, on these criteria, the subgenus *Boleosoma* is not a natural group. In some respects the *nigrum* group is closer to the subgenus *Ioa* than to the *stigmaeum* group, although *E. chlorosomum* is somewhat intermediate between the two groups of *Boleosoma*.

Cole (1957) noted that, as the spawning season for *E. nigrum nigrum* approached, the body became blackened; the W and X lateral markings became darker and appeared as diffuse blotches; the dorsal saddles became less pronounced; the head and lips became black; lines and spots on much of the body tended to disappear; the pelvic and anal elements became heavily blackened and the membranes became only slightly less blackened; the pectoral, dorsals, and caudal darkened; the pelvic spine and the first two or three rays and the more ventral elements of the pectoral fin acquired whitened knoblike tips. This tendency is shown to an extreme degree by one of Cole's (1957) undescribed subspecies of *E. nigrum*, in which the lower pectoral membranes became separated at the tips of the rays in the breeding males and females and ended in large, fleshy, whitish knobs. These knobs apparently serve to protect the tips of the rays during spawning and nest defense. Winn (1958b, p. 172) reported that males of *E. nigrum nigrum* were larger than females and had larger anal, first dorsal, second dorsal, pectoral, and pelvic fins, and had the first four or five spines of the first dorsal fin adorned with thickened, opaque, white tips. *E. n. nigrum* spawns upside down underneath rocks and the male subsequently defends the nest (Winn, 1958a; 1958b, fig. 5).

Breeding males of *E. olmstedi* also become very dark but not to so extreme a degree as in *E. nigrum* (Cole, 1957). *E. olmstedi* breeds in a similar manner to *E. nigrum* (Atz, 1940). Males of *E. longimanum* taken in April and June differ from females in having the pigment pattern virtually obscured by melanophores; the fins, the breast, belly, sides, and head are essentially black. The tip of the pelvic fin spine is swollen into a small white bulb. There are fleshy tips to the pectoral fin rays that are most conspicuous on the more ventral fin rays. Males are larger than females (Raney and Lachner, 1943). Males of *E. perlongum* taken on March 26 (CU 30035, Lake Waccamaw) have much darker fins than the females, especially the first dorsal, anal, and pelvic fins. Fleshy tips are present on the distal ends of the pelvic fin elements, but these are not as prominent as in *E. nigrum* or in *E. olmstedi*. Cole (1957) did not find tubercles in any species of the *nigrum* group.

Six collections containing tuberculate males of *E. chlorosomum* have been examined. They were taken between March 8 (TNHC 2374, Texas, San Jacinto Co.) and April 17 (USNM 166172, Texas, Lake Belmont). The best developed male (UMMZ 161309, Louisiana, Lincoln Par., April 7, 39 mm.) has thin, elongated tubercles distributed along the entire length of the ventral surface of the first two pelvic rays, the proximal three-fourths of rays 3 and 4, and the proximal quarter of ray 5. Their presence on the proximal part of the pelvic fin is very unusual; most darters have them best developed distally. A few poorly developed tubercles are scattered on the middle portions of anal rays 2–5 of this specimen. The other tuberculate males show similar patterns, although the tuberculate areas are not as extensive. None of the females are tuberculate. The genital papilla of the female is a swollen rugose pad, differing from that in the *nigrum* group (low and flowerlike) and that in the *stigmaeum* group (an elongate tube). Males of *E. chlorosomum* are darker than females, especially the first dorsal, anal, and pelvic fins, and the venter, but there is no approach to the black fins present in males of the *nigrum* group. Winn (1958b, p. 188) reported Clark Hubbs's observation that *E. chlorosomum* spawns on plants or debris.

Thirteen collections of *E. jessiae* (UMMZ, VPI, CU, USNM) containing tuberculate males were examined. These collections were taken from March 13 (UMMZ 103591, Tennessee, Campbell Co.) to April 10 (UMMZ 103709, 103687, 103676, Tennessee, Anderson Co.). Most males have tubercles only on the ventral scale rows, but at maximum development in March (UMMZ 103567, 114852, 103591) poorly developed tubercles are present on the ventral surface of pelvic rays 3 and 4, and a few are also scattered on the anal fin rays. At maximum development, ventral scale tubercles begin shortly behind the pelvic fin origin on one row of scales and extend onto 4–7 rows per side just anterior to the genital papilla, 2–3 rows above each side of the anal fin base, and a total of 3–4 midventral caudal peduncle scale rows. Males have darker fins and venters than females and have enlarged lateral blotches. The genital papillae of breeding females are thin, elongate tubes totally unlike the genital papillae of breeding females of the *nigrum* group. There is little or no trace of the fleshy tips that develop on the pectoral and pelvic fin rays in the *nigrum* group. In life, breeding males (USNM 187735, Tennessee, Little Pigeon R., April 1) have 8–10 narrow blue bars on the body, the anal fin is blue with a white submarginal band, the dorsals are blue basally with a submarginal red band on the first dorsal and a submarginal white band on the second dorsal. The blue coloration also extends out onto the caudal fin.

The tubercle development of males of *E. stigmaeum* is quite similar to that described above for *E. jessiae*, except that the fin tubercles are better developed (especially in smaller specimens), and there is a puzzling type of geographic variation present. Males of *E. stigmaeum* from Kansas, Kentucky, and Tennessee (UMMZ, USNM) are very similar to males of *E. jessiae* in pigmentation, maximum size of males, and great development of ventral scale tubercles as contrasted with fin tubercles; however, most males from Alabama and Mississippi (UMMZ) are smaller, have less well-developed pigmentation, and have the fin tubercles well developed and the ventral scale tubercles almost absent. This is contrary to most tuberculate darters, which have tubercles better developed in more southern populations. Further study may show subspecific or specific differentiations.

Tubercles are present on males of the northern populations of *E. stigmaeum* from April 6 (UMMZ 165344, Kentucky, E. Fork Barren R.) to April 24 (USNM 163074–5, Kentucky, Green R.). At maximum development (UMMZ 171769, Kansas, Spring R., April 7), ventral scale tubercles start at a point one-third of the distance from the pelvic to the anal fin origin and extend onto three rows of scales per side just anterior to the genital papilla. Tubercles are not present on the scales above the anal fin base or on the ventral surface of the caudal peduncle in any of the males I have examined, but they will probably be found to be present when additional material is examined. One of the three 37 mm. males in this collection shows the best development of anal fin tubercles; they are present on the second anal spine and on all of the soft rays. Pelvic fin tubercles are developed distally to the fork on the ventral surface of pelvic ray 3 and on the entire length of rays 4 and 5. There seems to be a tendency for the fin tubercles to be best developed in smaller specimens and the ventral scale tubercles to be best developed in larger males.

In the southern population of *E. stigmaeum*, fin tubercles but not ventral scale tubercles are present on males from four collections taken from April 2 (UMMZ 155359, Mississippi, Bogue Chitto R.) to May 4 (UMMZ 166388, Alabama, Luxapallila Cr.). A 36 mm. male from UMMZ 155359 has tubercles on the distal three-fourths of all the anal soft rays but none on the spines. A 29 mm. male (UMMZ 163553, Alabama, Big Escambia Cr.) has a few small tubercles on the distal half of the second anal spine. The 36 mm. male has the best developed pelvic fin tubercles on the distal three-fourths of the ventral surface of pelvic soft rays 2–4. Males in one southern collection (USNM 166055, Alabama, Alabama Dr., April 6) have poorly developed pelvic fin tubercles, lack anal fin tubercles, and have ventral scale tubercles starting one-third of the way posteriorly from the pelvic to the anal fin origin and extending onto 3 rows of scales just anterior to

the genital papilla, 0–2 rows above each side of the anal fin base, and onto 3 ventral caudal peduncle scale rows. This collection matches the description of the northern populations of *E. stigmaeum* more closely than the southern ones.

In studying the breeding behavior of Kentucky and Tennessee populations of *E. stigmaeum*, Winn (1958b, p. 172) found that males are larger than females and have larger anal and pelvic fins. He reported the presence of tubercles on the anal and pelvic fins of males but failed to find any on the ventral body scales. Cross and Minckley (1958) described the coloration of breeding males and noted tubercles on the anal fin rays. In spawning, the male mounts the female in such a manner that his tuberculate pelvic fins are in contact with her dorsum and his tuberculate anal fin and ventral scales are in contact with her sides (Winn, 1958a; 1958b, fig. 4). This spawning position is similar to that found in a number of other darters such as *E.* (*Oligocephalus*) *caeruleum* and *E.* (*O.*) *spectabile* and is totally unlike the complex inverted spawning position of the *nigrum* species group of *Boleosoma*. Winn (1958b, p. 188) felt that the placement of *stigmaeum* in *Boleosoma* should be reconsidered.

Subgenus *Ioa* Jordan and Evermann

The only known species is *E. vitreum* (Cope). Specimens taken from March 28 to May 17 (CU, UMMZ) lack tubercles. The males are larger than the females and become much darker in the breeding season, especially on the cheeks and venter. The genital papilla of the breeding female has many free fleshy villi. Winn and Picciolo (1960) noted the pigment differences between the sexes and did not mention the presence of breeding tubercles. They reported that *E. vitreum* spawns communally in mid-April on a solid surface in the path of a strong current. This behavior may have evolved from spawning under rocks practiced by some members of the subgenus *Boleosoma*. Winn and Picciolo listed several similarities between *E. vitreum* and *E. nigrum* in support of this hypothesis: the sexes are beside each other during spawning; one egg is laid at a time on a hard surface; males are very black in the breeding season; and females of both species have a complicated flowerlike genital papilla. The lack of breeding tubercles in *Ioa* and the *E.* (*Boleosoma*) *nigrum* species group further confirms this relationship.

Subgenus *Etheostoma* Rafinesque

Fifteen species are presently placed in this subgenus. The subgenus can be divided into two different tuberculate species groups and one nontuberculate group. Members of the *variatum* group, *variatum*

Kirtland, *tetrazonum* (Hubbs and Black), *euzonum* (Hubbs and Black), *kanawhae* (Raney), and *osburni* (Hubbs and Trautman) have breeding tubercles on the ventral scales in both sexes. This appears to be the only group of darters with both sexes tuberculate. (In the Romanichthyini, both sexes of *Zingel* and *Romanichthys* are tuberculate.) Species of the *variatum* group are heavy-bodied darters with prominent dorsal saddles. Breeding males of many of the species have bright colors. Species of the *inscriptum* group, *inscriptum* (Jordan and Brayton), *thalassinum* (Jordan and Brayton), *swannanoa* Jordan and Evermann, *blennioides* Rafinesque, and *gutselli* (Hildebrand), have similar but less prominent tubercles present only on the males. The tubercles in both groups, unlike the more conical ones present in most other percids, are low whitened pads on the free posterior edges of the ventral and lateral scales. The nontuberculate *zonale* group includes *zonale* (Cope), *rupestre* Gilbert and Swain, *histrio* Jordan and Gilbert, and probably *blennius* Gilbert and Swain. *E. sellare* (Radcliffe and Welsh) is apparently also nontuberculate, but it does not seem to be related closely to any of the three species groups.

Breeding tubercles are present on *E. variatum* from as early as October 5 (USNM 161783, Pennsylvania, Allegheny R.) until May 12 (CU 43070, New York, Allegheny R.). No tubercles are present on Allegheny River specimens taken in June or August. The October 5 collection has 27 females and 18 males (57–70 mm. in standard length) without tubercles and 8 males (60–66 mm.) with small tubercles on 2 rows of midventral scales per side just anterior to the genital papilla and on 4 rows on the midventral portion of the caudal peduncle. Four females (58–67 mm.) taken October 13 (USNM 161786) also lack tubercles while a 74 mm. male has small tubercles on 4 ventral scale rows per side just anterior to the genital papilla and on 4 midventral rows on the caudal peduncle. By April 19 (CU 34938) tubercles are present on 5 rows of ventral scales per side just anterior to the genital papilla. Females taken April 20 (CU 8226, fig. 5) have tubercles on about 6 rows of belly scales per side just anterior to the genital papilla. William J. Richards kindly called my attention to a male taken April 29 (CU 41893, New York, Allegheny R.) that has tubercles on the approximately 20 breast scales, on all the belly scales up to 6 rows per side just anterior to the genital papilla, 4–5 rows above the anal fin base, and 7 midventral scale rows on the caudal peduncle. Both May 12 males (CU 43070, 69–70 mm.) have tubercles extending onto 7 rows per side just anterior to the genital papilla. These males and CU 41893 also have tubercles on the ventralmost 2 rows of scales which extend onto the lower part of the caudal fin. The presence of breeding tubercles in *E. variatum* has not previously been reported although tubercles are plainly visible in a photograph of a breeding male (Hubbs

and Black, 1940, pl. 2, fig. 1). The tips of the pelvic elements are more swollen in males in CU 8226 than in females. The genital papillae of females are elongate tubes. The pelvic and anal fins of females are only slightly pigmented while those of breeding males are completely black, except for white fleshy tips on the anterior elements in both fins. The pectoral fins of females are banded, while in breeding males they are completely black. The breast and belly of females are nearly immaculate, while those of males are completely covered with melanophores. Both dorsal fins of males are more heavily pigmented than those of females. Lachner, Westlake, and Handwerk (1950) reported that males of *E. variatum* were larger, brighter, and more highly pigmented, and that they had larger pelvic and dorsal fins than females.

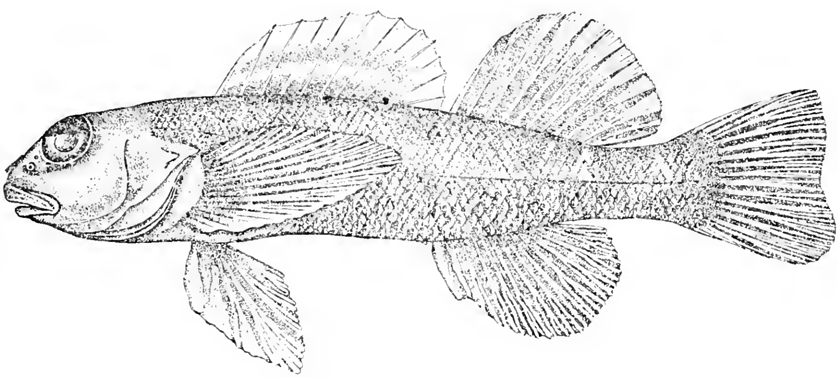

FIGURE 5.—Male of *Etheostoma* (*Etheostoma*) *variatum* showing the distribution of breeding tubercles (CU 8226, Pennsylvania, Shenango River, April 20, 72 mm. SL).

Males of *E. tetrazonum* taken in Missouri March 16 to April 6 (CU 32879, 37380, 37354; KU 7537) have tubercles on all the breast scales, on 3–5 rows of scales per side just anterior to the genital papilla; 1 row above the anal fin; and a total of 7 ventral caudal peduncle rows. The tubercles are best developed on the largest males but are obvious on other males down to 47 mm. standard length. Females have lower and much less prominent tubercles on 6 rows of midventral scales. Males are much darker than females, with the second dorsal, pelvic, and anal fins almost black. Bands on the pectoral, second dorsal, and caudal fins of females are completely obscured by dark pigment in males. The head, breast, and belly of males are also much darker than in females.

Tubercles are present on *E. euzonum* taken April 4 (CU 32900, Missouri, White R.), April 7 (KU 7634, Missouri, Current R.), and April 30 (TU 10175, Arkansas, White R.). In males they are present on the breast scales, on about 7 scale rows per side just anterior to the

genital papilla, 3 rows above the anal fin base, and 6–7 rows of ventral scales on the caudal peduncle. Females have a similar tubercle distribution, but the tubercles are smaller and do not extend as far dorsally. Tubercles are absent in specimens (UMMZ) taken in July and August.

The same tubercle distribution is present on specimens of *E. kanawhae* taken from April 1 (UMMZ 131838, North Carolina, New R.) to June 8 (USNM 162196 and 162197, Virginia, New R.). Males with maximum tubercle development (USNM 162197) have tubercles on 2 rows of scales at the pelvic fins extending onto 7 rows of scales per side just anterior to the genital papilla, 4 rows above each side of the anal fin base, and a total of 8 rows on the ventral caudal peduncle scales. The maximum development of tubercles observed in females is on a 66 mm. specimen from the same collection. Here tubercles also begin at the pelvic fins and extend onto 7 rows of scales just anterior to the genital papilla, but are present on only 2 rows of scales above each side of the anal fin base and on only 5 rows of caudal peduncle scales. Small tubercles are present on three males taken July 23 (UMMZ 165448, North Carolina, Little R., 57–66 mm.), but they are absent from a 61 mm. female from the same collection. Faint traces of tubercles are barely discernible on males taken as late as August 24 (UMMZ 169360, Virginia, Little Reed Island Cr.). In the original description of *E. kanawhae*, Raney (1941) mentioned that the holotype, as well as other males taken near the breeding season, had the scales on the belly and lower sides "tipped with pearl white." Tubercles are clearly visible in his photograph of a male paratype.

Tubercles are present on specimens of *E. osburni* taken between May 17 (USNM 117588, paratype; and UMMZ 95370, Virginia, Reed Cr.) and July 15 (UMMZ 118800, West Virginia, Indian Cr.); they are absent from specimens taken in August and October. At maximum development males have tubercles on 5–7 rows of midventral scales per side just anterior to the genital papilla, 3–5 rows above each side of the anal fin base, and on 4–8 rows on the caudal peduncle. Some of these tubercles have points on their posterior ends. Females have a similar distribution of tubercles, but they are lower, broader, and lack the points present on males. Males are darker than females, especially the pelvic, anal, and second dorsal fins, and the head. In their original description of *E. osburni*, Hubbs and Trautman (1932) did not mention the presence of breeding tubercles, but they can be seen in their figure of the holotype (UMMZ 92409). They are also present on a paratype (USNM 117588).

Thus the intimate relationships of the five species in the *variatum* group as noted by Hubbs and Black (1940) and Raney (1941) are

further corroborated by similarities in the distribution of breeding tubercles. With reservations, Hubbs and Black included *E. blennius* in their *variatum* group; I would tentatively remove it since it appears to be nontuberculate. They considered the possibility that *E. sellare* might belong to the *variatum* group; I feel this is highly unlikely.

Tubercle distribution in the *inscriptum* group is similar to that in the *variatum* group, but the tubercles are not on as many areas nor are they present in females. Tubercles are present on males of *E. inscriptum* in the Savannah Drainage at least from March 25 (CU 19548, 19755) until June 3 (CU 37935). At maximum development (USNM 165732, Georgia, Altamaha Dr., April 5), tubercles start one-fourth of the way posteriorly from the pelvic fin origin to the anal origin and extend onto 4 rows of scales per side just anterior to the genital papilla, 3 rows above the anal fin base and 5 ventral caudal peduncle rows. Males are much darker than females, especially the dorsal, anal, and pelvic fins, and the breast and the belly. There are two concentrations of pigment on the membranes of the first dorsal fin of males, anteriorly between the first 3 spines and posteriorly between the last 2 spines. The tips of the pelvic spine and, to a lesser extent, the lower pelvic rays are swollen in males. The general banded pattern of females is obscured by the increased body pigmentation of breeding males. The genital papilla of the breeding female is a very long thin tube.

E. thalassinum from the Santee Drainage of North and South Carolina has virtually the same tubercle pattern as *E. inscriptum*. Tubercles are present at least during the period March 23 (USNM 187567, 187580; CU 10113, 19662; UMMZ 138494) until April 20 (USNM 187578, 187582). Four females collected on February 27 (USNM 187576) are filled with large eggs and I believe males are probably tuberculate at this time. The maximum development of tubercles observed is on a 57 mm. male taken on April 19 (USNM 187573). Tubercles start posteriorly one-fourth of the way from the pelvic fin origin to the anal origin and extend onto 4 rows of scales per side just anterior to the genital papilla, 3 rows above the anal fin base, and a total of 5 ventral caudal peduncle rows. Tubercles are less well developed in the earlier part of April. Tubercles are absent from males taken June 25 to November 6. All females lack tubercles. Males are darker than females, especially the pelvic and anal fins, which in females are immaculate.

Males of *E. swannanoa* taken between April 1 (UMMZ 138521, Virginia, Holston R.) and June 7 (CU 37886, North Carolina, French Broad R.) have tubercles on the ventral scales. At maximum development (UMMZ 138482, North Carolina, Swannanoa R.), the tubercles begin one-third of the way posteriorly from the pelvic fins to

the origin of the anal fin and extend onto 4–5 rows of scales per side just anterior to the genital papilla, 3–4 rows above each side of the anal fin base, and 5 rows of ventral scales on the caudal peduncle. Specimens collected from June 17 to August 15 (UMMZ) lack tubercles. Females also lack tubercles. Females of *E. swannanoa* have the longest genital papillae in relation to body size that I have found in any darters. A 61.4 mm. female had a genital papilla 5.9 mm. long.

I have examined four collections containing tuberculate males of *E. blennioides*. In addition, Dr. Robert V. Miller, who is presently reviewing the taxonomy of this species, has kindly provided me with his notes on tubercles and called my attention to two collections containing tuberculate specimens. Tubercles are present on males of *E. blennioides* at least as early as March 24 (CU 37520, Kentucky, Licking R.) until June 26 (UMMZ 96357, Tennessee, Cumberland R.). At maximum tubercle development (CU 20629, Pennsylvania, Genesee R., April 27), tubercles start a third to halfway posteriorly from the pelvic fin origin to the anal fin, extend onto 4–6 rows per side just anterior to the genital papilla, 1–3 rows above each side of the anal fin base, about 5–6 rows of ventral caudal peduncle scales, and are found also on some of the small scales at the ventral part of the base of the caudal fin. By June 26 (UMMZ 96357), tubercles have almost disappeared. Spawning occurs in New York between April 13 and June 12 (Fahy, 1954, p. 167), so there is a good correlation with the presence of tubercles. Tubercles are absent on females. Winn (1958b, p. 172) and Lachner, Westlake, and Handwerk (1950) reported that males were larger than females and had larger first dorsal and anal fins. Winn also reported that males had larger pectoral and pelvic fins. Lachner et al. found the pelvic fins of both sexes to be of about equal size, the second dorsal fin larger and the pectoral fin smaller in males. The tips of the pelvic spines and most of the soft rays are slightly more swollen in breeding males than in breeding females. Males are much darker, especially the head, venter, and body, and the pelvic and anal fins.

E. blennioides spawns at a horizontal to a vertical angle, usually at about 45° (Winn, 1958a; 1958b). Spawning takes place over *Cladophora*-covered rocks in the deepest and swiftest parts of stream riffles (Fahy, 1954, p. 169). The male mounts the females with his pelvic fins over her dorsum and his tuberculate lower sides in contact with her sides (Winn, 1958a; 1958b, fig. 4).

In his studies on *E. gutselli*, Miller has found only two tuberculate specimens, which he has generously permitted me to examine. Both are males, 87 and 91 mm. long, taken in the northeastern corner of Georgia May 9 (UG uncat.). Small, low tubercles begin halfway posteriorly from the pelvic fins to the anal fin origin and extend onto

4 rows of scales per side just anterior to the genital papilla. A few tubercles are present on the scales above the origin of the anal fin base, but they are absent posteriorly. Miller has not found tubercles on any females of this species. Males are very dark with the lateral markings almost obscured. The tubercle and pigment patterns of *E. gutselli* confirm its close relationship to *E. blennioides*.

Four of the five remaining species currently placed in the subgenus *Etheostoma* can be assigned to the nontuberculate *zonale* group. These are *rupestre*, *zonale*, *histrio*, and probably *blennius*. Proper allocation of the fifth species, *E. sellare*, is difficult at present. Hubbs and Black (1940) considered that it might belong to the *variatum* group because of its bold back markings. However, the two types of *E. sellare* are both spring-caught females and lack tubercles, rendering this unlikely. I do not feel that it is closely related to any of the three species groups of the subgenus *Etheostoma*, but I cannot suggest a better group to place it in.

Specimens of *E. rupestre* taken in April and May (USNM 166029 and UMMZ 166372, Alabama, Tombigbee R.; TU 19896 and UMMZ 171762, Alabama, Cahaba R.) lack tubercles. Both males and females have the tips of the pelvic spines and most of the soft rays tipped with cream-colored fleshy knobs. Females have the anal and pelvic fins and the breast and belly immaculate, whereas males have these areas and the dorsal fins very dark. The testes and ovaries of these specimens are greatly enlarged. Specimens of *E. zonale* in 16 collections (USNM, UMMZ) taken from March 1 (TU 8170, Mississippi, Pearl R.) to June 21 (UM 5219A) lack tubercles. The pigmentation differences between the sexes are very similar to those in *E. rupestre*. Lachner, Westlake, and Handwerk (1950) reported that males of *E. zonale* were larger than females and had larger dorsal fins. Specimens of *E. histrio* in August, October, and January collections (USNM, UMMZ) and in a March 25 Texas collection (TNHC 1114) are nontuberculate. Males of *E. histrio* taken in January and March have greatly enlarged testes and the females are filled with large eggs. Spring caught specimens of *E. blennius* (UMMZ) lack tubercles, but sufficient material has not yet been examined to be sure this species belongs to the *zonale* group.

Subgenus *Ulocentra* Jordan

There are four described species: *atripinne* (Jordan), *coosae* (Fowler), *duryi* Henshall, and *simoterum* (Cope), plus about nine undescribed species, in this subgenus (R. M. Bailey, pers. comm.). I have examined some breeding material of all described species as well as a number of the manuscript forms (mostly UMMZ specimens). Males of all species are brightly colored in life and apparently lack breeding

tubercles. In the absence of tubercles, as well as in other characters, the subgenus *Ulocentra* seems most closely related to the *Etheostoma* (*Etheostoma*) *zonale* species group.

Winn (1958b, p. 172) noted that males of two of the undescribed forms of *Ulocentra* (from the Barren and Green rivers of Kentucky) were larger than the females, had larger anal, first dorsal, and pelvic fins, and lacked breeding tubercles. These two species usually spawn in a nearly vertical position with the male mounted on the female's back (Winn, 1958a; 1958b, fig. 4).

Subgenus *Allohistium* Bailey

There is only a single species: *E. cinereum* Storer. The testes and pigmentation of a spring-caught male (CU 37281, Tennessee, Cumberland R., March 26, 56 mm.) are well developed and breeding tubercles are absent. Males in six collections taken later in the year (ANSP, UMMZ, USNM) have slightly developed testes and also lack tubercles.

Subgenus *Nothonotus* Agassiz

There are seven described species in this subgenus: *acuticeps* Bailey, *camurum* (Cope), *jordani* Gilbert, *maculatum* Kirtland, *moorei* Raney and Suttkus, *rufilineatum* (Cope), and *tippecanoe* Jordan and Evermann. Apparently this subgenus lacks breeding tubercles, although I have not examined adequate breeding material of *acuticeps* or *tippecanoe*.

Bailey (1959) described the sexual dimorphism in color as well marked in *Nothonotus*. He wrote (p. 3): "All species are colorful, varying from subdued to gaudy. The breast is blue or green in adult males . . . . The body is lined with dark in several species; the soft dorsal, caudal, and anal fins are dark-edged in some, and the fins may be somber or brightly colored with red, orange, or green . . . . No species has a submarginal red or orange band in this [first dorsal] fin." For *E. acuticeps*, he reported (p. 8): "It is probable that no nuptial tubercles are developed since adults taken in June, and nearly ready to spawn, have none." Raney and Suttkus (1964) reported that nuptial tubercles are absent in *E. moorei*. Raney and Lachner (1939) noted that males of *E. maculatum* attain a larger size than females. In addition, Winn (1958b, p. 172) reported that males have larger anal, first and second dorsal, pectoral, and pelvic fins than females. He described the genital papilla of the breeding female as flattened and flowerlike, and he did not find breeding tubercles on the male. *E. maculatum* spawns under rocks and the male defends the nest (Raney and Lachner, 1939). *E. camurum* spawns in gravel around or under

rocks in a spawning position similar to that described by Winn (1958b, fig. 4) for *E. caeruleum* (Mount, 1959).

Subgenus *Oligocephalus* Girard

Twenty-one species are presently placed in this, the largest subgenus of *Etheostoma*. There appear to be three different tuberculate species groups and one nontuberculate group. Males of the *nianguae* group, *nianguae* Gilbert and Meek and *sagitta* (Jordan and Swain), have conical tubercles on the ventral scales. Males of the *radiosum* group, *radiosum* (Hubbs and Black), *whipplii* (Girard), and *caeruleum* (Storer) have tubercles that are similar to but not as high as those in the *E. nianguae* group. Eight other tuberculate species may best be placed together for the present, although they differ from one another in the details of tubercle distribution: *punctulatum* (Agassiz), *fricksium* Hildebrand, *hopkinsi* (Fowler), *parvipinne* Gilbert and Swain, *spectabile* (Agassiz), *luteovinctum* Gilbert and Swain, *pallididorsum* Distler and Metcalf, and *cragini* Gilbert. The species in the *spectabile* group

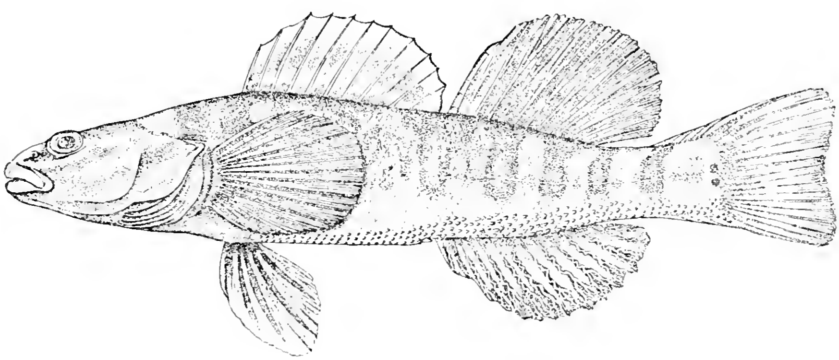

FIGURE 6.—Male of *Etheostoma* (*Oligocephalus*) *nianguae* showing the distribution of breeding tubercles (CU 32888, Missouri, Osage River, March 16, 89 mm. SL).

differ from the two previous groups in having tubercles on the anal fin. Two of the species in this group have tubercles on only the anal fin, while the others also have them in additional regions. This leaves a residue of eight species which appear to be nontuberculate: *asprigene* (Forbes), *swaini* (Jordan), *mariae* (Fowler), *juliae* Meek, *pottsii* (Girard), *lepidum* (Baird and Girard), *exile* (Girard), and *grahami* (Girard).

A fine breeding male of *E. nianguae* (CU 32888, Missouri, Miller Co., Big Tavern Cr., Mar. 16, 1957, a specimen overlooked by Kuehne and Bailey, 1961) has breeding tubercles well developed on about 12 mid-ventral scale rows just anterior to the genital papilla (fig. 6). There are no tubercles on either the pelvic or anal fins. There is, however, a

sinuous ridge of fleshy material extending along each element of the anal fin. A 51 mm. male of *E. sagitta sagitta* (USNM 144485, Kentucky, Cumberland R., April 8) has tubercles on the ventral scales beginning halfway posteriorly from the pelvic to the anal fin and extending onto 3–4 rows of scales per side just anterior to the genital papilla. The tubercles are high and conical. None are present above the anal base or on the lower surface of the caudal peduncle. However, a larger specimen from the same field collection (UMMZ 144492) has tubercles on 2 rows of scales above each side of the anal fin base and on 5–6 midventral rows on the caudal peduncle, as Bailey (1948) has previously noted. I have not yet examined a tuberculate specimen of *E. sagitta spilotum* Gilbert. The similarity of breeding tubercle distributions further confirms the intimate relationships of *E. nianguae* and *E. sagitta* as pointed out by Bailey (1948, in describing the subgenus *Litocara* for the three forms), and Kuehne and Bailey (1961).

There are tubercles on the ventral scales of males of *E. radiosum* in nine collections taken between April 4 and April 25 in the Red River drainage of Oklahoma and Arkansas: USNM 165772, 165797, 165865, 165866; UMMZ 161368 holotype, UMMZ 161369, and MCZ 37205 paratypes of *E. radiosum paludosum* (Moore and Rigney); USNM 153532 and MCZ 37204, paratypes of *E. radiosum cyanorum* (Moore and Rigney). A 52 mm. male from USNM 153532 has the best developed tubercles, located on 3 rows of ventral scales starting about one-fourth of the way from the pelvic origin to the anal origin. They are slightly raised, circular mounds on the posterior edge of the scales, not pads as in the *variatum* group. The tubercles on the ventralmost scales have elongate points on their posterior end. Just anterior to the genital papilla, tubercles are present on about 6 scale rows per side. They are on 5 rows of scales above each side of the anal fin base and on 7 midventral rows of scales on the caudal peduncle. The tubercle patterns are similar in the larger males in the other collections, but the tubercles are smaller and are not developed on as many scale rows. None of the more than 120 females in these collections show any sign of tubercle development and all the larger females have the ovaries filled with large eggs. The genital papilla of the female is an elongate cone. The pelvic fin and venter of the female are immaculate, the anal fin is moderately pigmented, and the dorsal fins are somewhat blotched and banded. In the male, the pelvic fin and venter are very dark, the dorsals, anal, and caudal fin are heavily pigmented on the basal half and have a light (orange in life) strip followed by a dark distal edge to the fin. In their original description of *E. radiosum paludosum*, Moore and Rigney (1952) reported tubercles on the bellies of males. In spawning, the female *E. radiosum cyanorum* partially buries herself in sand

and the male mounts her with his pelvic fins clasped over her dorsum and his tail pressed tightly against hers (Linder, 1958).

The same tubercle pattern was found on males of *E. whipplii* taken between February 29 (UMMZ 177250, Arkansas, Illinois Bayou) and April 12 (TU 17771, Texas, Neches R.). At the maximum development observed (UMMZ 155103, Kansas, Crooked Cr., April 9; and UMMZ 177160, Arkansas, Illinois Bayou, April 3), tubercles begin one-third of the way from the pelvic fin origin to the anal fin origin, extend onto 5–7 rows of scales per side just anterior to the genital papilla, on 2–3 rows above each side of the anal fin base, and onto 6–8 midventral rows of caudal peduncle scales. Specimens taken earlier (UMMZ 177250, February 29) and later (TU 17771, April 12) lack tubercles above the anal fin base and on the ventral surface of the caudal peduncle.

The tubercle pattern of *E. caeruleum* seems to be the same as that of *E. radiosum* and *E. whipplii*. Leslie W. Knapp, who is reviewing the systematics of *E. caeruleum*, has kindly given me his data on tubercles of this species and has permitted me to examine the specimens with the best developed tubercles. Poorly developed tubercles are present in 15 collections taken in Missouri and Arkansas between March 27 (CU 37190, Missouri, Madison Co.) and June 5 (KU 5605, Missouri, Gasconade R.). Males from an Illinois collection (INHS uncat., Rock R., April 25) are at the height of breeding color according to Knapp and show the best development of tubercles. A 51 mm. male from this collection has tubercles present on the belly scales starting halfway from the pelvic to the anal fin origin and extending onto 4 rows of scales per side just anterior to the genital papilla, on 2–3 rows above the anal base, and on about 5 midventral rows on the caudal peduncle. There are no tubercles on the fins of these or many other breeding males examined. Winn (1958b, p. 172) reported that males of *E. caeruleum* are larger than females and have larger anal, first dorsal, pectoral, and pelvic fins, but he failed to find breeding tubercles. In spawning, the female of *E. caeruleum* partially buries herself in the gravel of the stream bottom and the male mounts her (Winn, 1958a; 1958b, fig. 4). Since the belly and sides of the male are then in contact with the sides of the female, the tubercles may assist him in maintaining his position.

Temporarily, at least, the other eight tuberculate species of the subgenus *Oligocephalus* may be placed together in the *spectabile* group based on the presence of breeding tubercles on the anal fin of males. *Etheostoma parvipinne* and *E. fricksium* have tubercles on the anal fin alone. The other six species, *hopkinsi, cragini, punctulatum, luteovinctum, pallididorsum,* and *spectabile,* have tubercles in other areas as well. Females of all six species lack tubercles.

Numerous males of *E. parvipinne* taken early in 1952 in a tributary of the Yazoo River, Mississippi, have tubercles on the anal rays. A 55 mm. male taken February 22 (USNM 196636), has tubercles on the distal fourth of the first anal soft ray, the distal half of the second ray, the distal half to two-thirds of rays 3–5, and the distal third of rays 6–7. There are no tubercles on the anal spine or the last anal soft ray. Males taken later in the spring (exact dates unknown) have similar tubercle distributions, but the tubercles are larger and extend farther proximally on the rays. (Some specimens from the original collections, UM 47 and 521A, have been recatalogued as USNM 196636, 196637, UMMZ 162907.) Two 44 mm. males taken March 7 (TNHC 2835, Texas, Montgomery Co.) have tubercles developed on the distal half to three-fourths of all anal soft rays. There are no pelvic or body tubercles on any of the specimens. The belly and pelvic fins of the females are immaculate. These areas, plus the anal and dorsal fins, are dark in the males. Males taken from April 4 to April 22 (UMMZ) lack tubercles.

Bailey and Richards (1963) stated that breeding tubercles are present on the lower surface of the pelvic fin, anal fin, and on the ventral body scales of breeding males of *E. hopkinsi.* Richards has very kindly called my attention to the only tuberculate specimens he has examined. Males of *E. hopkinsi binotatum* Bailey and Richards are tuberculate from as early as March 25 (CU 19604, S.C.) until April 29 (UG 283, Georgia) in the Savannah River drainage. The maximum development of tubercles is on a 39 mm. male collected March 27 (CU 19600, South Carolina, Savannah Dr.). A few tubercles are present on the distal tip of the second anal spine and 5–10 prominent tubercles are present on all the anal soft rays except the last half of the last ray. Small but prominent tubercles are developed on the ventral surface of the proximal portion of pelvic soft rays 3–5. Tubercles (and scales) begin halfway posteriorly from the pelvic fins to the origin of the anal fin and extend onto 3–4 rows of scales per side just anterior to the genital papilla. No tubercles are present above the anal fin base or on the ventral surface of the caudal peduncle.

Dr. Richards has also permitted me to examine the tuberculate specimens he has found of *E. fricksium.* A few very small tubercles are on anal soft rays 3–6 of two males (CU 17375, Georgia, Savannah Dr., 46–50 mm.) taken March 24. Tubercles are also present on the anal rays of males taken in the Edisto drainage (CU 29850, South Carolina, March 28). Additional tuberculate specimens are needed to determine whether tubercles develop on the pelvic fins and venter of *E. fricksium* as they do on *E. hopkinsi.* If not, tubercle pattern will be one additional difference between the two species which had been confused until recently (Bailey and Richards, 1963).

Tubercles were found on males of *E. cragini* collected from January 1 (UMMZ 156694, Kansas, Meade Co.) to May 7 (KU 5658, Missouri, Shoal Cr.). Tubercles are best developed on two males from UMMZ 156694 (30 and 31 mm.), on the 50 mm. male syntype of the nominal species *E. pagei* Meek (USNM 45566, Missouri, Neosho R., Apr. 15, 1893), and on a specimen collected April 5 (CU 32919, Missouri, Neosho R., 32 mm.). In the latter specimen, tubercles are present on most of the length of the anal spines and soft rays, on the distal two-thirds of the pelvic spine, and the distal third of the first three pelvic soft rays (ventral surface). No tubercles are present on the dorsal surface of the pelvic rays in this specimen, but there are a few tubercles on the distal tip of pelvic rays 1 and 2 in KU 7233. On the CU specimen, tubercles also are present on the ventral scales starting posteriorly one-third of the distance from the pelvic to the anal fin origin. They extend onto about 5 rows of scales per side just anterior to the genital papilla and onto 2–3 rows above each side of the anal fin base. No tubercles are present elsewhere on these specimens nor are they present on the females. Tubercles are absent from the abundant UMMZ material of *E. cragini* collected in June, July, and August. Moore and Cross (1950) reported tubercles on the anal rays of males of *E. cragini* taken January 1 (UMMZ 156694). They also found tubercles on the pelvic fins, the ventral scale rows near the anal base, and along the belly of breeding males taken February 2 in Mayes Co., Oklahoma.

A similar tubercle distribution is present on some of the paratypes of the closely related *Etheostoma pallididorsum*. Nine males collected April 6 (KU 6158, Arkansas, Caddo R.) are tuberculate. All have tubercles along both anal spines and on all the anal soft rays. Pelvic fin tubercles are poorly developed on the 5 smaller specimens (29, 31, 33, 34, and 35 mm.), better developed on two larger specimens (35 mm.), and best developed on the two largest specimens (37 mm.). Here they are present on the distal three-fourths of the pelvic spine and first pelvic soft ray (dorsal and ventral surfaces), the distal three-fourths of ray 2 (ventral surface), and distal half of ray 2 (dorsal surface), the distal third of ray 3, and the distal quarter of ray 4 (ventral surface only). The ventral scale tubercles are best developed on a 35 mm. male where they begin halfway between the pelvic and the anal fins, extend onto 4 rows of scales per side just anterior to the genital papilla, 2 rows above each side of the anal fin base, and are present on the ventral surface of the caudal peduncle. Tubercles are absent in another collection of paratypes (USNM 196547) taken June 28. The identical tubercle distributions in *E. pallididorsum* and *E. cragini* serve as further evidence of their very close relationship. In their original description, Distler and Metcalf (1962) reported

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tubercles on the anal fin rays and on the belly scales of the paratypes described above.

Males of *E. punctulatum* in seven collections (UMMZ, KU, CU, TU) taken from January 30 (TU 22993, Oklahoma, Neosho R.) to May 2 (TU 2251, Oklahoma, Arkansas R.) have tubercles. They are present on the anal spines and soft rays of males taken in this period but are best developed on the soft rays. A 54 mm. male (CU 37346, Missouri, Osage R.) taken March 28 has the maximum tubercle development observed. There are 15–20 tubercles on each anal soft ray, fewer on the anal spines. Tubercles are present on the ventral surfaces of all pelvic fin elements, ranging in number from 5 (on the spine) to 30 (on the second soft ray). Tubercles are present on the dorsal surfaces of pelvic soft rays 1–3 as well as on the ventral surfaces. Tubercles are also present on about 7 rows of the ventral scales per side just anterior to the genital papilla and on about 6 rows along each side of the anal fin base. There are a few small tubercles on the ventralmost principal caudal ray.

Males of *E. luteovinctum* are tuberculate from at least March 26 (CU 37235) until April 28 (UMMZ 121612) in Duck River, Tennessee. Tubercles develop earliest and remain for the longest period of time on the anal fin. Except for tubercles on the anal spines, the males in CU 37235 have the best developed tubercles of the specimens examined. No tubercles are present on the first anal spine, a few are present on the second anal spine, and there are 5–10 tubercles on each of the anal soft rays. There are no tubercles on the ventral surfaces of the pelvic fin elements, but four intermediate-sized specimens have several tubercles distally on the dorsal surface on soft rays 1 and 2. Ventral tubercles start halfway from the pelvic to the anal fin and extend onto 4–5 scale rows per side just anterior to the genital papilla, 3 rows along each side of the anal base, and 5 midventral rows on the caudal peduncle. A few tubercles are present on the ventralmost principal caudal ray in the largest specimen. No tubercles are present on the pectoral fin. Some males (UMMZ 120985) have tubercles on the first instead of the second anal spine. Others (UMMZ 121259) have tubercles on both anal spines, although the tubercles are not as well developed in the other regions as in CU 37235. The nine collections with tuberculate males contained no tuberculate females.

Tubercles are present on the anal, pelvic, pectoral, and caudal fins and on the ventral scales of the males of *E. spectabile*. I have found tubercles on males of *E. s. spectabile* taken in late March (CU 37240, Missouri, Osage R.; CU 37496, Tennessee, Barren R.; CU 37436, Arkansas, White R.) and in early April (CU 38406, Missouri, Osage R.). Tubercles are present on 61 males (26–42 mm. standard length)

of *E. spectabile pulchellum* (Girard) taken April 20 (USNM 165807, Oklahoma, Poteau R.). At their maximum development, tubercles are present along the entire length of the anal fin elements and on the ventral surfaces of all the pelvic soft rays. Tubercles are also developed on the dorsal surfaces of pelvic soft rays 1–3 and on the anterior surfaces of pectoral rays 6–8. There are tubercles on about 4 rows of ventral scales per side just anterior to the genital papilla, on 4–5 rows above the anal fin base, and on 8 midventral rows on the caudal peduncle. A few males (CU 37436, fig. 7) have scattered small tubercles on the lower caudal rays. Males of *E. spectabile* are much

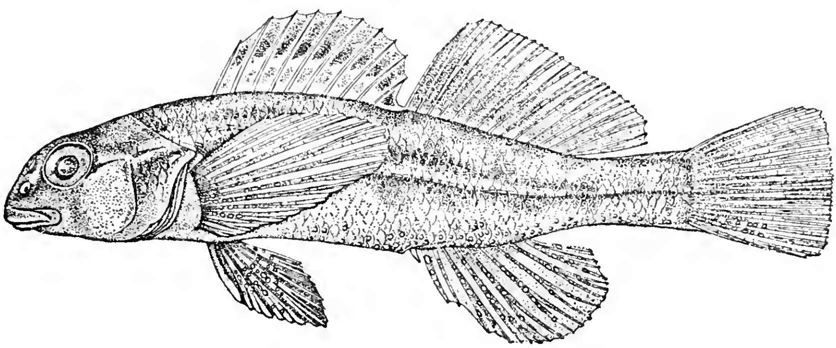

FIGURE 7.—Male of *Etheostoma* (*Oligocephalus*) *spectabile* showing the distribution of breeding tubercles (CU 37346, Arkansas, White River, March 29, 44 mm. SL).

darker than females, especially the pelvic, anal, dorsal, pectoral, and caudal fins, and on the breast and belly. The tips of the pelvic fin spine and, to a lesser extent, the pelvic and lower pectoral fin rays, have slightly swollen, unpigmented tips. Winn (1958b, p. 172) reported that males of *E. s. spectabile* were larger than females and had larger anal, first dorsal, pectoral, and pelvic fins, but he found no tubercles. In spawning, the male mounts the female after she has buried herself in the gravel of the bottom of the stream bed (Winn, 1958a; 1958b, fig. 4; Linder, 1958). The tuberculate pelvic fins of the male are in contact with the female's back; and his belly, sides, and caudal peduncle are pressed against hers.

The residual, apparently nontuberculate group of eight species of *Oligocephalus* (*asprigene, exile, grahami, juliae, lepidum, mariae, pottsii* and *swaini*) probably are not closely related to each other. Certainly they are quite diverse in general body form and pigmentation. The following list of numbers and sources of collections with included dates shows the relative adequacy of coverage of the species in this group: *asprigene*, 6 collections, Nov. 21 to June 16 (CU, USNM, TU, UMMZ); *exile*, 6 collections, May 14 to August 26 (UMMZ); *grahami*

(UMMZ 162135, Mexico, Nuevo Leon, Dec. 19, 14 males, 27–36 mm., and 35 females; TNHC 1971, Texas, Val Verde Co., April 14, 10 males, 29–40, mm., and 14 females; testes of males in both collections greatly enlarged and females filled with large eggs); *juliae*, 11 collections, Oct. 25 to Aug. 22 (TU, CU, UMMZ); *lepidum*, 6 collections, Feb. 4 to June 25 (CU, UMMZ, USNM); *mariae*, 5 collections, April 1 to June 29 (CU, UMMZ, TU, USNM); *pottsii* (USNM 162482, Feb. 14; USNM 55855, no date; TNHC 4032, June 26; testes enlarged in males, females filled with large eggs); and *swaini*, 5 collections, Jan. 28 to April 4 (TU, CU, UMMZ). Winn (1958b) found that females of *E. exile* are larger than males. Males have larger anal and first dorsal fins and lack breeding tubercles. Spawning takes place at a slight angle over organic debris and fibrous mud banks with the male mounted on the female's back (Winn, 1958a; 1958b; fig. 4). Strawn (1955a, 1955b) described the breeding colors of *E. lepidum* and *E. grahami* but did not mention breeding tubercles.

Subgenus *Villora* Hubbs and Cannon

There are two species in this subgenus: *E. okaloosae* (Fowler) and *E. edwini* (Hubbs and Cannon). I have examined virtually all the available material of *edwini* and Ralph W. Yerger has done the same for *E. okaloosae* (see Collette and Yerger, 1962). Both sexes of both species are nontuberculate. Males of *E. edwini* are larger than females and have large orange-red spots over the entire body and fins. These spots are also present in females, but they are smaller and less widely distributed. Males of *E. okaloosae* are slightly larger than females and both sexes lack red spots. The genital papilla of the breeding female is a low tube crowned with villi (Collette and Yerger, 1962, fig. 7).

The larger size of males, the absence of tubercles, and the shape of the genital papilla in females are three of the characters that differentiate *Villora* from the subgenus *Hololepis*, under which it has been synonymized by Bailey (*in* Bailey and Gosline, 1955). These characters help to substantiate my belief that *Villora* is an offshoot of the *asprigene–swaini* nontuberculate group of the subgenus *Oligocephalus* (Collette and Yerger, 1962, p. 214).

Subgenus *Austroperca* Hubbs

Males of *E. australe* Jordan, the only known species in this Mexican subgenus, taken on May 21 (UMMZ 136124, Chihuahua) and March 28 (UF 10127, Durango) have slightly enlarged testes and lack tubercles.

Subgenus *Psychromaster* Jordan and Evermann

No tubercles are present on the available material of *E. tuscumbia* Gilbert and Swain. Three males (USNM 125096, Alabama, Tennessee R., 36–38 mm.) which were apparently taken in the spring, although the date is unknown, have greatly enlarged testes and no tubercles. A 41 mm. female in this collection is filled with moderate-sized eggs. Males in a large collection taken on May 26 (UMMZ 104244, Alabama, Wheeler Reservoir) have the testes only slightly enlarged; the females are filled with large eggs.

The second species in this subgenus, *E. trisella* Bailey and Richards, is known only from the juvenile holotype.

Subgenus *Catonotus* Agassiz

This subgenus is composed of five described species: *flabellare* Rafinesque, *kennicotti* (Putnam), *obeyense* Kirsch, *squamiceps* Jordan, and *virgatum* (Jordan), plus several undescribed forms. All the species appear to be nontuberculate. The subgenus may, however, be divided into two species groups on the basis of another sexually dimorphic character. Both sexes of *E. kennicotti* and the males of *E. flabellare* and *E. squamiceps* have cream-colored, fleshy bulbs at the tips of the spines in the first dorsal fin. The tips of the dorsal spines in *flabellare*, and to a much lesser extent in *kennicotti*, are modified into a Y-shaped fork which supports the fleshy bulbs. These fleshy tips are essentially absent in both sexes of *E. obeyense* and *virgatum*, although small incipient bulbs are occasionally visible. Males of all species are darker than females, especially the pelvic, anal, and first dorsal fins, head, breast, and belly. Winn (1958b, p. 172) reported that males of *E. flabellare* were larger than females, had larger anal, pectoral, and pelvic fins, and lacked breeding tubercles. *E. flabellare* has a complex mating behavior which culminates in a pair spawning head to tail upside down underneath a rock (Lake, 1936, fig. 1; Winn, 1958a; 1958b, fig. 5).

Subgenus *Hololepis* Agassiz

This subgenus consists of six species: *serriferum* (Hubbs and Cannon); *gracile* (Girard); *zoniferum* (Hubbs and Cannon); *fusiforme* (Girard), with two subspecies; *saludae* (Hubbs and Cannon); and *collis* (Hubbs and Cannon), with two subspecies (Collette, 1962). Males of all species of *Hololepis* have tubercles on the anal rays and on the undersides of the pelvic fin rays. Males are generally darker than females, especially their dorsal, anal, and pelvic fins, and the venter. Females are larger than males or of about equal size. Males

of *E. gracile* and *E. zoniferum* have supplementary tubercles on the rami of the lower jaw and in life have vertical green bars on the sides and red spots on the first dorsal fin. Sexual dimorphism in these two species confirms their close relationships (Collette, 1962). Complete descriptions of coloration and breeding tubercles, photographs of sexually mature specimens, and drawings of breeding tubercles have been presented recently (Collette, 1962). Hubbs and Cannon (1935) reported tubercles in *E. serriferum*, *E. gracile*, and *E. fusiforme*.

The following account of tubercles in *Hololepis* is summarized from my recent revision (Collette, 1962). *E. serriferum* has tubercles most developed during late March, when they are present on the distal two-thirds of the anal fin rays and the distal third of the pelvic fin rays (Collette, 1962, p. 119 and fig. 1i). Hubbs and Cannon (1935) also found tubercles on the soft rays of the anal and pelvic fins of *E. serriferum*. Tubercles are present on *E. gracile* from February 19 (TNHC 4994, Texas, Red R.) to April 19 (KU 2418, Oklahoma, Red R.). Maximum development occurs in mid-March in Texas, when tubercles are present on the distal half of the anal rays, the distal three-fourths of the underside of the pelvic spine and rays, and in two rows of four tubercles on each ramus of the lower jaw (Collette, 1962 pp. 135–136 and figs. 1k, m). Hubbs and Cannon (1935) reported tubercles on the anal and pelvic fins and on the lower jaw of *E. gracile*. Cross (1954) also noted tubercles on the chin of this species. I found tubercles on only the anal rays and lower jaw rami of *E. zoniferum* (UMMZ 163758, Alabama, Tombigbee R.). I think they will be found on the pelvic rays also if sufficient material becomes available (Collette, 1962 p. 149–150). Tubercles are present on *E. saludae* from at least April 16 (CU 35019) until March 14 (CU 35036). At the maximum stage of development, tubercles are found on the distal three-fourths of the anal rays and on most of the ventral surface of the first four pelvic soft rays (op. cit., p. 191–192). In my limited material of *E. collis*, tubercles are developed on *E. c. collis* on March 22 (CU 11988) and on *E. c. lepidinion* Collette on March 31 (CU 29992). They are present on the underside of the pelvic fins and on most of the anal fin rays (op. cit., pp. 198, 205; fig. 1g).

There is geographic variation in tubercle development in *E. fusiforme*. Of thousands of specimens examined, tubercles were found on only a few specimens in 14 collections of the northern subspecies, *E. fusiforme fusiforme* (op. cit., p. 153), while they were commonly found on the southern *E. f. barratti* (op. cit., p. 175). Tubercles are present on *E. f. fusiforme* from March 25 (CU 29983, North Carolina, Ellis Lake) to May 17–18 (CU collections, New Jersey). They are present on *E. f. barratti* from October 27 (FSU 3273, Fla.) to May 29 (UG 516, South Carolina, Pee Dee R.) and are at their maximum de-

velopment from March 25 to May 29. Tubercles are present on more specimens for a longer period of time and are also better developed in the southern subspecies. I have found a similar type of geographic variation in *Percina* (*Percina*) *caprodes* and *Etheostoma* (*Oligocephalus*) *spectabile.* Egami (1954) also found a north–south difference in the development of dermal contact organs on the cyprinodontid *Oryzias latipes* (Temminck and Schlegel). Hubbs and Cannon (1935) found tubercles on the anal and pelvic fins of *E. f. barratti*, but only on the anal fin of *E. f. fusiforme.*

E. f. fusiforme is the only form that I have watched courting. The male mounts the female and "beats" her nape with the tuberculate undersides of his pelvic fins. At the same time, his tuberculate anal fin is in contact with the posterior part of her caudal peduncle. Thus the tubercles on the pelvic fins of males of *E. f. fusiforme* may serve to stimulate the female while the anal fin tubercles aid in maintaining contact. Fletcher (1957) has presented a photograph of a spawning pair.

The presence of breeding tubercles on the pelvic and anal fins of *Hololepis* and *Microperca,* and their absence from *Villora,* is one of the reasons I feel the first two subgenera are closely related to each other and not to *Villora* (Collette, 1962).

Subgenus *Microperca* Putnam

This most specialized subgenus of *Etheostoma,* contains three closely related species: *fonticola* (Jordan and Gilbert), *microperca* Jordan and Gilbert, and *proeliare* (Hay). Males of all three species have breeding tubercles on the anal rays and on the ventral surfaces of the pelvic fin rays as in the subgenus *Hololepis.* The fins of the males are all much darker than those of the females, especially the first dorsal, pelvic, and anal. Winn's description (1958b, p. 172) of the other sexually dimorphic features of *E. microperca* will serve equally well for the other two members of the subgenus: females larger than males; males with larger pectoral and pelvic fins; genital papillae of females elongate and tubelike; pelvic fins of males extremely long, with the outer ridge of thickened skin forming a cup (Petravicz, 1936, figs. 1, 2). The cuplike pelvic fins are furnished with tubercles which probably function in stimulation of the female or in maintenance of the spawning position (Petravicz, 1936, figs. 3, 4; Winn, 1958b, fig. 4).

Moderate sized conical tubercles are present on males of *E. fonticola* taken April 12 (USNM 166101, TU 4746, TU 5024, Texas, San Marcos R.). Tubercles are located on the distal tip of the first pelvic soft ray, on the entire length of pelvic soft rays 2–4, and on the distal

half of the last pelvic soft ray. Tubercles are also present on the distal seven-eighths of all elements of the anal fin.

Two males of *E. proeliare* (USNM 165959, Mississippi, Big Black R., April 8) have tubercles on all elements of the anal fin, on the tip of the first pelvic soft ray, and on the entire length of pelvic soft rays 2–5. Seventeen males (28–32 mm. standard length) from the Red River, Louisiana (USNM 172733), taken January 12, lack tubercles as do over 40 females. Seven other males in this collection (30–32 mm.) have tubercles on the distal half of pelvic soft ray 3 and a few scattered tubercles on the distal end of the second and fourth soft rays. Two males have a few tiny tubercles on the fourth anal ray. Thus, the tubercles seem to form first on the middle soft rays of the pelvic fin, spread to the other pelvic soft rays, and then develop on the anal fin rays.

Tubercles are present on males of *E. microperca* from as early as April 16 (UMMZ 81525, Michigan, Kalamazoo R.) until as late as July 10 (UMMZ 67927, Michigan, Big Wolf Cr.). They are absent on specimens taken from July 19 to December 21 (USNM), but few specimens are available from January through March. Tubercles develop first and remain for a longer period of time on the pelvic fin rays than on the anal fin rays. The maximum development I have observed is on males taken May 3 (UMMZ 73144 and 73158, Michigan, Au Sable R.). Tubercles are present on the entire length of the ventral surfaces of all the pelvic elements and on the anal spines. I have not seen specimens with tubercles developed on any of the anal soft rays as I have in the other two species of the subgenus. This poor development of tubercles is probably correlated with the northerly occurrence of *E. microperca*. A similar situation has also been shown in *Percina* (*Percina*) *caprodes*, *Etheostoma* (*Oligocephalus*) *spectabile*, and *E.* (*Hololepis*) *fusiforme fusiforme*. Petravicz (1936) failed to find tubercles on *E. microperca*, and Winn (1958b, p. 172) reported them on only the pelvic fins. *E. microperca* spawns in an approximately vertical position on plants. The male is mounted on the female's back with his tuberculate cuplike pelvic fins clasped over her back and his tuberculate anal fin in contact with her sides (Winn, 1958b, fig. 4).

Summary

Breeding tubercles are now known for 48 species in five genera of the Percidae. Tubercles in the Percidae are mainly distributed laterally and function primarily in facilitating contact between the male and female during the spawning act. Tubercles may have a stimulatory function, especially in the species that have them on the undersurface of the pelvic fins. Breeding tubercles are of value in classification at two levels.

First, they are present in the members of the tribe Etheostomatini, subfamily Percinae, and in the members of the tribe Romanichthyini, subfamily Luciopercinae. This fact might seem to suggest that the Romanichthyini and the Etheostomatini should be placed together, separate from the Percini and Luciopercini. When coupled with other characters, such as the reduction of the air bladder, the small body size, and the utilization of lotic rather than lentic habitats, this arrangement seems even more reasonable. However, as I have shown by using osteological characters (Collette, 1963), the relationships of the Etheostomatini are with the Percini, and those of the Romanichthyini are with the Luciopercini. Closer analysis of the distributions of tubercles confirms this. In the Etheostomatini, tubercles are concentrated on ventral and ventrolateral surfaces, such as the undersides of the pelvic fins, the anal fin, the lower part of the caudal fin, the scales on the belly, and the sides up to the lateral line. In the Romanichthyini, tubercles are concentrated on the dorsal and dorsolateral surfaces, the top of the head, the dorsal fins, the pectoral fin, and the body scales primarily above the lateral line. This difference in the distribution of tubercles may indicate a different mode of spawning in the two tribes. Unfortunately, there appears to be no information available about spawning in the members of the Romanichthyini. Breeding tubercles and other characteristics that are similar in the two tribes have probably arisen as independent adaptations to a bottom-dwelling mode of life in streams.

Within the Etheostomatini, patterns of tubercle development are useful in showing phylogenetic relationships. The character has no value at the generic level, at least if three large inclusive genera, *Percina*, *Ammocrypta*, and *Etheostoma*, are recognized. However, within each of the two larger genera (*Percina* and *Etheostoma*) tubercle patterns offer an additional character in defining subgenera and species groups within subgenera.

In *Percina*, there are five nontuberculate subgenera (*Hypohomus*, *Alvordius*, *Hadropterus*, *Swainia*, and *Cottogaster*), two tuberculate subgenera (*Percina* and *Imostoma*), and one heterogeneous subgenus (*Ericosma*). On the basis of this character, perhaps the tuberculate *P.* (*Ericosma*) *evides* is not as intimately related to the nontuberculate *P. crassa* and *P. palmaris* as previous workers have indicated.

Males of all four species in the subgenus *Ammocrypta* and the one species in the subgenus *Crystallaria*, genus *Ammocrypta*, are tuberculate. I think that the tubercle distributions in these species will be found to be virtually identical, although I have not yet seen tubercles on the anal fin of *A.* (*A.*) *pellucida* and I have found tubercles on the caudal fin of *A.* (*A.*) *clara* alone. Thus, tubercle patterns agree with other characters that lead to synonymizing *Crystallaria* with *Ammocrypta*, at least at the generic level.

The greatest problems in the classification of the Percidae lie in the largest genus, *Etheostoma*. Twelve subgenera were utilized by Bailey (*in* Bailey and Gosline, 1955) and one more recently has been recognized (Collette and Yerger, 1962).

The subgenus *Boleosoma* is composed of at least two groups: the nontuberculate *nigrum* group of five species and the tuberculate *stigmaeum* group of three species, although in some other characters, *chlorosomum* of the latter group tends to be somewhat intermediate between the two. The nontuberculate monotypic subgenus *Ioa* clearly seems to be derived from the nontuberculate *nigrum* group. Further study may lead to synonymizing *Ioa* under *Boleosoma*, and removing *E. stigmaeum*, *E. jessiae*, and *E. chlorosomum* from *Boleosoma* and placing them in *Vaillantia* Jordan. Similarities in spawning behavior between *Ioa* and the *nigrum* group in contrast to the *stigmaeum* group reinforce this idea.

The subgenus *Etheostoma* can be divided into two closely related tuberculate groups and one nontuberculate group. The *variatum* group of five species is the only one in the Etheostomatini where both sexes are tuberculate. Other authors have previously pointed out the close relations which members of the *variatum* group have to one another. The *inscriptum* group of five species differs from the *variatum* group in that only the males develop tubercles. Four of the remaining five species (*rupestre, histrio, zonale*, and *blennius*) presently placed in the subgenus form a closely related nontuberculate group. This group appears to be somewhat intermediate between the *variatum* and *inscriptum* groups on the one hand and the nontuberculate subgenus *Ulocentra* on the other. It will be necessary to await the description of some nine new species of *Ulocentra* presently in manuscript by Reeve M. Bailey before a full appraisal can be made of the relations between the *zonale* group and *Ulocentra*. The two type specimens of *E. sellare* are females caught in the spring; they are not tuberculate. Therefore, it probably should not be placed in the *variatum* group, although a number of authors have indicated that its relationships are with that group. *E. sellare* does not appear to be close to either the *inscriptum* or *zonale* groups and I am not satisfied that it belongs in the subgenus *Etheostoma*.

The monotypic subgenera *Allohistium* and *Austroperca* are apparently nontuberculate. *Psychromaster* is also apparently nontuberculate. The lack of tubercles in all species of *Nothonotus* and *Catonotus* further indicates the compact nature of each of these subgenera.

The largest subgenus, *Oligocephalus*, contains about 20 species which belong in at least four species groups. The three forms of the *nianguae* group are very closely related to each other as was noted by Bailey (1948) and Kuehne and Bailey (1961). The *radiosum* group is similar to the *nianguae* group in having tubercles on the body scales,

but this may not be an indication of close relationship. The *spectabile* group consists of nine species, all of which have tubercles on the anal fins of males. All but *E. parvipinne* and *E. fricksium* of this group have tubercles on the ventral scales and the pelvic fins. *E. punctulatum*, *E. luteovinctum*, and *E. spectabile* also have additional tubercles on the lower part of the caudal fin and *E. spectabile* even has tubercles on the pectoral fin. Probably most of the remaining eight species are nontuberculate.

Both species of the subgenus *Villora* lack breeding tubercles, further indicating that *Villora* is probably an offshoot of the nontuberculate group of *Oligocephalus*, perhaps from somewhere near *E. swaini* and *E. asprigene*, and consequently it was removed from synonymy with *Hololepis* (Collette and Yerger, 1962).

The presence of breeding tubercles on the anal and pelvic fins of the species in the subgenus *Hololepis* shows its close relationships with the subgenus *Microperca* and not with *Villora* (Collette, 1962). The presence of tubercles on the chin of *E. gracile* and *E. zoniferum* confirms other evidence that these two species of *Hololepis* are especially closely related (Collette, 1962).

Thus, the patterns of breeding tubercles confirm the close relationships within many subgenera and species groups of the Percidae and indicate that several other groups may need rearranging.

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LAND SNAILS OF THE GENUS AMPHIDROMUS FROM THAILAND (MOLLUSCA: PULMONATA: CAMAENIDAE)

By Alan Solem [1]

Introduction

Among the many zoological collections made in Thailand by the late Hugh M. Smith in the 1920's and 1930's were 91 sets of *Amphidromus* containing almost 500 specimens. This is by far the largest and most varied collection known from Thailand and greatly increases our knowledge of the distribution and variation of Thailand species. Through the courtesy of Dr. Harald A. Rehder, Division of Mollusks, U.S. National Museum, it was possible to prepare this report on Smith's collections. Unless otherwise indicated, all material discussed below was collected by Hugh M. Smith and is deposited in the U.S. National Museum (USNM). Notes are included on some additional material in the Academy of Natural Sciences of Philadelphia (ANSP), and a few duplicates from Smith's sets are deposited in Chicago Natural History Museum (CNHM).

[1] Curator, Lower Invertebrates, Chicago Natural History Museum, Chicago, Ill.

An annotated catalogue of *Amphidromus* (Laidlaw and Solem, 1961) was completed before this study was undertaken, and, for the sake of brevity, literature references are restricted to the original citations and the discussion in the recent catalog.

The laborious calculation of standard deviations was performed by Mr. Ernest J. Roscoe.

Cited localities.—Variant spellings of Thailand city and place names are numerous, requiring great care in designating localities. Fortunately, a gazeteer of Smith's collecting stations and a condensed itinerary of his travels has been given by Riley (1938). All the localities mentioned below can be located through use of this paper.

Distribution in Thailand.—Nine species were recognized in the available material. Accepting the zoogeographic division into Southeast, East, Central, North, West, and Peninsular Thailand (Riley, 1938), the most species are found in Peninsular and Southeast Thailand, seven and six respectively; the fewest in West and North Thailand, one and two respectively. The larger, "typical" *Amphidromus*—*A. inversus annamiticus* and *A. atricallosus*—are concentrated in Southeast and Peninsular Thailand although *A. atricallosus* extends into the nearby fringes of Central, West, and East Thailand. *A. areolatus*, *A. semitessellatus*, and *A. schomburgki* (to a lesser extent) also show the Peninsular and Southeast Thailand distribution. There are single records for *A. areolatus* in both Central and East Thailand, while *A. schomburgki* is apparently common in East Thailand. *A. xiengensis* is known from North, Central, and Southeast Thailand, *A. sinensis indistinctus* from North and (?) Peninsular Thailand, and *A. fultoni* from a single juvenile collected in Peninsular Thailand. These data are insufficient to allow other than the most general statements. Obviously the number of species drops off sharply from South to North, and the northern part of Thailand represents the fringes of distribution for *Amphidromus*. In Burma, Pakistan, and part of India, some *Amphidromus* are known from more northerly latitudes than in Thailand, but the distributional picture in Laos, North Viet Nam, and possibly Southern China is uncertain.

Review of species.—Laidlaw and Solem (1961) recognized 20 species groups in *Amphidromus*, divided into the subgenera *Syndromus*, *Goniodromus*, and *Amphidromus* sensu stricto, and a "base stock" series of six groups from mainland Southeast Asia that could not be assigned to subgenera with any degree of assurance. They hypothesized that *Syndromus*, *Goniodromus*, and *Amphidromus* represented directions of differentiation that were well marked on Indonesian islands but had not become clearly recognizable on the mainland. Study of the Thailand material confirmed this impression of close affinities among the mainland species, particularly in regard to

A. xiengensis, *A. areolatus*, and *A. semitessellatus*. Typical examples were immediately separable, but several sets were examined that were exceedingly difficult to allocate. What I have called *A. areolatus* is relatively small (23–28 mm. high) with a closed to moderately open umbilicus, thin shell, usually a reddish columellar patch, and brown and yellow spiral zones on the base of the shell. *A. semitessellatus* is a larger (28–39.5 mm. high), much thicker and heavier shell, with the columella nearly straight, and the basal portion of the aperture sharply rounded or actually angulated, the umbilicus closed or a narrow chink, with purple, yellow, or no subsutural bands, and only medial interruption of the radial streaks (when present). *A. xiengensis* is usually a large (30-39 mm. high) shell with a red subsutural line, narrowly to widely open umbilicus, columella curved and basal margin of aperture broadly rounded; the radial streaks (when present) interrupted by one to several spiral zones. Shells from Kao Sabab, tentatively referred to *A. xiengensis*, are smaller (27.5–34.3 mm. high), lack the red subsutural band, have a more sharply rounded basal margin of the aperture, but show the *xiengensis* color pattern. Another set from Kao Pae Nam have the size, subsutural line, and radial streaks of *A. xiengensis*, but the columellar patch and aperture of *A. areolatus*. It is tentatively grouped with *A. xiengensis*.

While sets of *A. xiengensis*, *A. semitessellatus*, and *A. areolatus* are usually readily separable, single specimens or short series of worn shells are difficult to identify. As indicated below, each species has a typical color pattern, but individual variations with almost complete loss of color pattern occur in each species. The demonstrated occurrence of dwarf ecotypes in *Amphidromus* prevents size criteria from being utilized as a distinguishing feature. Probably a combination of ecological, anatomical and conchological studies will be necessary before the relationship of the various forms can be accurately determined.

The Thailand shells are listed in the same sequence used by Laidlaw and Solem (1961).

Amphidromus sinensis var. *indistinctus* Pilsbry, 1900

Plate 1 (fig. 10)

Amphidromus sinensis var. *indistinctus* Pilsbry, 1900, Man. Conch., ser. 2, vol. 13, p. 192, pl. 62, fig. 70 [mountains of Laos].—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 523.

Two adult shells from Ban Nam Kien (USNM 405863) and Ampur Chiengdao (USNM 420332), North Thailand, are unquestionably this form. They are, respectively, 35.7 and 35.1 mm. high, h/d

ratios 1.96 and 1.94, with 7 and 6½ whorls. A third shell from Kao Chong, Patalung(?) (USNM 419829), is 28.6 mm. high, h/d ratio 1.91, with 6½ whorls. It is slightly thinner than the other two and the surface is relatively worn. Possibly it is misidentified.

Amphidromus glaucolarynx (Dohrn, 1861)

Plate 2 (fig. 1)

Bulimus glaucolarynx Dohrn, 1861, Proc. Zool. Soc. London, 1861, p. 207, pl. 26, fig. 7 [Siam].

Amphidromus glaucolarynx (Dohrn).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, pp. 524–525.

Specimens of the relatively obese *A. g.* f. *fasciatus* von Martens were seen from Wang Kien (USNM 427382), Srakeo (USNM 419794), and Petchaburi (USNM 365544) in Central Thailand plus Pak Chong (USNM 367511) in East Thailand. Three of the four adults are sinistral, the fourth dextral. Height ranges from 32.7–38.2 mm., h/d ratio 1.63–1.84, whorls 6 to 6⅞.

Amphidromus schomburgki (Pfeiffer, 1860)

Bulimus schomburgki Pfeiffer, 1860, Proc. Zool. Soc. London, 1860, p. 137, pl. 51, fig. 9 [Siam].

Amphidromus schomburgki (Pfeiffer).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 526.

Material from Sriracha (USNM 405883a), Hinlap (USNM 420314), and Kao Sabab at 1,000 feet elevation (USNM 427328) in Southeast Thailand; Lam Tong Lang near Pak Chong (USNM 365461, USNM 427374), Pak Chong (USNM 365462, USNM 365540, USNM 405907, USNM 405910), Chantuk near Pak Chong (USNM 427370), Lat Bua Kao near Pak Chong (USNM 419883), and Aranya Predesha (USNM 405862) in East Thailand; and Pran (USNM 419800), Peninsular Thailand, represents mostly the *moellendorffi* color phase, with purple tip and green deciduous periderm. A few specimens have the stripes yellow brown rather than green and one shell (USNM 405907) has the purple spiral bands on the first five whorls, thus approaching the typical color phase. Two shells (USNM 365540 from Pak Chong) and one of three from Chantuk (USNM 427370) have white—not purple—lips, calluses, and spires. The Chantuk shell has a purple tip. The specimens from Sriracha show the same dwarfing, when compared with Pak Chong examples, that are found in the forms of *A. atricallosus* from the Sriracha area. Variation in size and shape is summarized in table 1.

TABLE 1.—*Size variation in* Amphidromus *of Thailand*

(E=East Thailand; SE=Southeast Thailand; P=Peninsular Thailand; N=North Thailand)

Species, locality, USNM nos.	No. of specimens	Height			Diameter			H/D Ratio			Whorls
		Mean	Range	S.D.	Mean	Range	S.D.	Mean	Range	S.D.	Mean
A. schomburgki											
Pak Chong, E (365462)	10	49.0	45.6–56.8	3.30	26.7	24.8–30.0	1.48	1.84	1.75–1.91	.053	7 3/16
Sriracha, SE (405883a)	5	40.4	36.1–42.4	2.48	24.7	23.7–25.9	0.83	1.63	1.52–1.69	.066	6½
Lam Tong Lang, E (427374, 365461)	21	49.3	40.1–55.9	3.83	27.0	23.5–30.1	1.62	1.82	1.69–2.00	.089	7¼
A. inversus annamiticus											
Koh Samet, SE (419153)	13	44.1	39.4–49.3	2.92	24.4	22.5–26.0	1.26	1.81	1.65–1.97	.131	7
Koh Samet, SE (384154)	11	42.2	33.9–47.8	4.41	23.6	22.2–24.5	0.95	1.79	1.53–1.96	.138	6½
Bandon, P (361481)	22	46.0	41.8–50.5	2.56	26.3	24.7–27.7	0.94	1.75	1.68–1.85	.052	7⅜
A. semitessellatus											
Sam Roi Yot, P (420457, 420458)	9	36.0	33.9–39.3	1.72	17.5	16.7–18.4	0.57	2.06	1.93–2.22	.090	6 13/16
A. xiengensis											
Chiengdao, N (419906, 420330, 420333)	21	34.8	31.2–38.5	2.26	17.4	16.4–18.9	0.82	2.00	1.81–2.20	.089	6 11/16
Kao Sabab, SE (427316, 427324, 427336)	7	30.1	27.5–34.3	2.18	15.4	14.7–16.9	0.80	1.95	1.81–2.08	.095	6⅞

Amphidromus atricallosus (Gould, 1843)

PLATE 1 (FIGS. 1–3, 8–9)

Bulimus atricallosus Gould, 1843, Proc. Boston Soc. Nat. Hist., vol. 1, p. 140 [Philippine Islands (error)].

Amphidromus atricallosus (Gould).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, pp. 530–531.

This is a common and variable species in Peninsular and Southeast Thailand. There are a few scattered records from the mountains along the Cambodian border, but otherwise this species is unknown from most of the country. Four distinctive color phases can be recognized. They are:

1. Typical *atricallosus* (pl. 1, fig. 1): parietal callus brown or purplish-black with one or more dark varices on the spire.

2. Form *leucoxanthus* von Martens, 1864 (pl. 1, fig. 8): one or more varices present, but the parietal callus without dark markings.

3. Form *perakensis* Fulton, 1901 (pl. 1, fig. 9): varices and parietal coloration absent, subsutural white zone usually more marked than in the other varieties.

4. Form *laidlawi*, new color form [2] (pl. 1, fig. 3): whitish shell with narrow, rather crowded, pale brown radial streaks that parallel the lines of growth. One or more varices are usually present.

The first three forms were described as full species, and their type figures are markedly different in size, shape, and coloration. *A. atricallosus* was based on the relatively large (50–55 mm. high), elongated, bright yellow shells from Tenasserim, Burma; *A. leucoxanthus* von Martens, on the whiter, more obese, slightly smaller shells subsequently found in Southeast Thailand; and *A. perakensis* Fulton, on the large, elongated, pale yellow shells with a sharply twisted columella that are common in Perak and northern Malaya. The variations in pattern, size, shape, and columellar configuration extend through the range of the species and it does not seem practical, at this time, to delineate subspecific units.

Color and columellar variation in the adult Thailand shells examined is indicated in the list of material by the following abbreviations:

L=*leucoxanthus* coloration
P=*perakensis* coloration with a distinct columellar plait
S=*laidlawi* coloration

[2] Holotype: USNM 363619 from Nong Khor, Southeast Thailand. Great pleasure is taken in naming this beautiful new form after the late Mr. F. F. Laidlaw of Foxearth, Sudbury, Suffolk, England, who is responsible for my interest in *Amphidromus* and who graciously allowed me the privilege of coauthoring his catalog of the genus (Laidlaw and Solem, 1961).

T=*atricallosus* coloration
Lc=simple, untwisted columella
Pc=a twisted columella or columellar plait present.

Thus the notation after a catalog number of "9 L, 3 S+Pc" indicates that the set contained nine shells with *leucoxanthus* coloring and simple columella and three shells with *laidlawi* coloration and a twisted columella. Since most *leucoxanthus, atricallosus,* and *laidlawi* variations had simple columellas and most *perakensis* forms had twisted columellas, it was thought necessary to list only the exceptions.

The following sets of Thailand *A. atricallosus* were examined:

Peninsular Thailand.—Ban Huey Ta, west of Nakron Sritamarat: USNM 405659 (juvenile); Chumporn, west side of the Gulf of Siam: USNM 420275 (juvenile); Sichon, southeast of Bandon: USNM 405903 (1 T); USNM 405872 (4 T); Kao Luang, west of Nakron Sritamarat: USNM 419189 (2 T); Kao Chong, east of Trang: USNM 427306 (1 P); Kao Soi Dao, west of Singora and southeast of Trang: USNM 427311 (4 P); Tha Lo, southwest of Bandon: USNM 384157 and USNM 419151 (9 T, 4 T without varices, 3 L, 1 S+Pc, 1 P+Lc).

West Thailand.—Prachuab Kirikhan (=Koh Lak), west side Gulf of Siam: USNM 427292 (5 T).

Central Thailand.—Srakeo, near Krabin: USNM 419793 (1 P).

Eastern Thailand.—Lem Sing, Chantabun: USNM 405864 (1 L, 1 L+Pc), USNM 420286 (1 L); Kao Lem Sing, Sankambeng Range: USNM 384152 (3 L+Pc); Pak Chong (=Pak Jong): USNM 365463 (1 S).

Southeast Thailand.—Nong Yang, east of Sriracha: USNM 384158 and USNM 384158b (3 L, 7 L+Pc, 2 P, 2 S, 1 S+Pc); Nong Khor, near Sriracha: USNM 363617 (juvenile), USNM 363616 and USNM 405861 (19 P, 2 P+Lc, 13 L, 9 L+Pc, 1 T, 1 P+S), USNM 363619 (7 S, 2 S+Pc), USNM 367510 (6 L, 2 L+Pc, 1 P, 1 S); Hoi Yang, near Sriracha: USNM 420288 (3 P, 4 L), USNM 410489 (2 L+Pc), USNM 420290 (1 S); Sriracha, Gulf of Siam: USNM 405883 (worn), USNM 427345 (1 L, 1 L+Pc, 1 S+Pc); Ban Sadet, between Sriracha and Hupbon: USNM 363618 (1 L, 2 L+Pc); Chantabun (=Chantaburi): USNM 427341 (1 P, 1 P+Lc); Kao Sabab, near Chantabun: USNM 427331 (worn, most Pc); USNM 529518 (1 L); Koh Kut, island in Gulf of Siam: USNM 405835 (1 P+Lc); USNM 419788 (1 P); Kao Saming, in coastal plain near Krat: USNM 419184 (juvenile); Krat (=Trad), on Krat River: USNM 405655 (3 L, 4 L+Pc, 3 S+Pc); Kao Bantad, east of Krat near Cambodia: USNM 405858 (6 L+Pc, 1 P, 1 S, 1 S+Pc).

The distribution of the color phases is obviously not uniform. Thus, while two-thirds of the specimens from Peninsular Thailand are of the *atricallosus* phase, only one of the 119 shells from Southeast Thailand has the darkened parietal callus. Similarly, 21 of the 23 known *laidlawi* are from Southeast Thailand. The *leucoxanthus* and *perakensis* color forms seem less restricted in area, and it is certain that simple and twisted columellas occur in many localities. The larger samples from Kao Bantad, Nong Khor, Nong Yang, Krat, and Tha Lo contained a mixture of color forms and, while Southeastern

and Peninsular Thailand probably have different proportionate representation of color forms, there is no evidence that this is indicative of subspecific differentiation.

The specimens of *atricallosus* pattern from Tha Lo had the extent of the parietal coloration noticably reduced and there is one lot of four shells (ANSP 284220, CNHM 109473) from "Khao Luang," a mountain west of Prachuab Kirikhan[3] at 11°40′ on the Burmese-Thailand border that are quite unusually patterned (pl. 1, fig. 2). They have the callus and varix of *atricallosus*, but a reddish-brown color suffusion on the body whorl that is intensified into vague radial streaks and spiral color zones with hint of a peripheral spiral yellow fillet as in the *sultanus* and *interruptus* phases of *A. perversus*. The color pattern of *A. comes* is similar. Specimens from Prachuab Kirikhan have purplish banding on the upper whorls that is similar to that found in *A. janus*. No other color variations require special comment.

Size and shape variation is summarized in table 2. While there are great differences in size and shape between, for example, the Nong Khor and Prachuab Kirikhan populations, this probably reflects local ecological conditions rather than true geographic variation, since the Kao Sabab, Kao Bantad, Krat, and Kao Lem Sing samples from Eastern and Southeastern Thailand are in the size range of the Prachuab Kirikhan population rather than the dwarfed shells from the Sriracha area. Specimens of *Amphidromus schomburgki* from Sriracha are similarly dwarfed when compared with Pak Chong examples (see above), and it is probable that the Sriracha region is a marginal area for *Amphidromus*.

Variation in *A. atricallosus* within Southeast Thailand, for example, is much greater than differences (except in color frequency) observed in comparing specimens from the different zoogeographic areas of Thailand, and there thus seems to be no basis for recognizing subspecies. Possibly collections from the Tenasserim area may result in delineating a moderately restricted geographic range for the *atricallosus* predominance, but, in view of the great color variation, I would hesitate to create subspecies on color pattern frequencies.

Some strikingly colored shells from the Anambas Islands are referred to the *leucoxanthus* pattern. One from Pulo Telaga (USNM 161934) and six adults from Pulo Riabu (USNM 161923) are most similar to the orange shells figured by Pilsbry (1900, pl. 54, figs. 78–79). Possibly these are the "*A. chloris*" reported by Jacobi (1895) from

[3] This locality of de Schauensee should not be confused with the Kao Luang west of Nakon Sritamarat that was visited by Smith. "Khao Luang" is the same as Smith's Kao Luong.

TABLE 2.—*Size variation in* Amphidromus atricallosus

(W=West Thailand; P=Peninsular Thailand; E=East Thailand; SE=Southeast Thailand)

Locality and USNM nos.	No. of specimens	Height			Diameter			HD/ratio			Whorls
		Mean	Range	S.D.	Mean	Range	S.D.	Mean	Range	S.D.	Mean
Prachuab Kirikhan, W (427292)	5	52.4	47.0–56.9	4.12	28.4	25.1–31.2	2.36	1.85	1.79–1.87	.035	7
Kao Soi Dao, P (427311)	4	49.3	47.1–51.3	1.65	25.7	24.4–26.5	1.02	1.93	1.86–20.3	.076	7
Tha Lo, Bandon, P (384157, 419151)	20	44.2	40.1–52.2	2.59	24.4	22.3–26.2	1.01	1.81	1.71–1.99	.076	6¾
Sichon, P (405872)	4	47.5	46.3–49.2	2.39	25.6	24.9–26.6	0.76	1.87	1.85–1.88	.015	6¾
Kao Lem Sing, E (384152)	3	51.3	50.1–53.1	—	26.2	25.4–26.7	—	1.96	1.90–2.09	—	7⅛
Lem Sing E (420286, 405864)	3	45.7	44.6–47.5	—	25.5	25.2–26.0	—	1.79	1.77–1.84	—	6¾
Kao Bantad, SE (405858)	9	48.5	45.4–51.9	1.87	27.5	26.1–28.5	0.78	1.77	1.60–1.91	.087	6¾
Kao Sabab, SE (427331)	20	48.3	45.1–54.4	2.47	26.9	25.0–29.4	1.11	1.79	1.64–1.90	.082	6⅞
Krat, SE (405655)	10	47.1	45.8–50.2	1.44	26.7	25.9–27.6	0.58	1.76	1.67–1.88	.063	6¾
Ban Sadet, SE (363618)	4	44.7	42.4–46.9	2.33	26.0	25.2–26.7	0.67	1.73	1.71–1.77	.041	6¾
Nong Yang, SE (384158, 384158b)	15	42.7	35.4–48.0	3.10	24.8	22.1–26.3	1.37	1.72	1.60–1.87	.067	6 11/16
Hoi Yang, SE (420288)	7	41.5	37.7–44.9	2.69	24.0	22.8–24.5	0.78	1.73	1.66–1.84	.058	6¾
Sriracha, SE (405883)	11	41.5	38.4–44.0	1.90	24.8	22.3–26.1	1.59	1.68	1.58–1.78	.055	6 7/16
Nong Khor, SE (363619)	9	41.0	37.4–44.9	2.06	24.0	21.9–24.9	1.04	1.71	1.62–1.82	.065	6¾
(367510)	10	40.6	36.8–44.2	2.36	23.3	21.9–25.6	1.24	1.75	1.62–1.86	.084	6½
(363616, 405861)	45	39.6	36.0–45.4	1.99	23.6	21.5–26.8	1.24	1.70	1.57–1.82	.057	6⅝

the Anambas Islands. The USNM material was collected by W. L. Abbott in 1899 and 1900. No soft parts are available.

***Amphidromus inversus annamiticus* (Crosse and Fischer, 1863)**

Bulimus annamiticus Crosse and Fischer, 1863, Journ. de Conch., vol. 11, pp. 357–359 [Saigon].

Amphidromus inversus annamiticus (Crosse and Fischer).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 561.

Specimens of this subspecies were seen from Bandon, Peninsular Thailand (USNM 361481), on trees in the town; Koh Sichang (USNM 405866), an island off Sriracha near the head of the Gulf of Siam, Southeast Thailand; and Koh Samet (USNM 384154, USNM 384200, USNM 419153, USNM 419804), an island in the Gulf of Siam, Southeast Thailand. The shells from Bandon are much larger than those from Koh Samet (see table 1), probably reflecting the well-known small island dwarfing effect on land snails. Most specimens have a white background color, but some have the reddish tint of variety *roseotincta* von Moellendorff.

***Amphidromus areolatus* (Pfeiffer, 1861)**

Plate 1 (figs. 4–7)

Bulimus areolatus Pfeiffer, 1861, Proc. Zool. Soc. London, 1861, p. 194 [Siam].

Amphidromus areolatus (Pfeiffer).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 564.

A number of diverse color forms are grouped with some hesitation. Few specimens were available and only one of the color phases was seen from several localities. Possibly some subspecific division may be warranted when more material can be studied. The seven observed color forms are:

1. Three shells from Kao Chong (USNM 427307) in Peninsular Thailand have two purplish red basal bands—the upper much narrower than the lower—that are separated by an intense yellow band margined by narrow white zones. There are slight traces of a reddish columellar patch. The tip is purple and the spire white or pale yellow (pl. 1, fig. 4). This pattern is the same as that of *A. sinensis*, which differs in being a much larger, heavier and usually more globose shell. Both measurable adults from Kao Chong are 24.7 mm. high with 6 whorls.

2. Four shells from Tale Sap (USNM 361448), Peninsular Thailand, have the basal pattern of the above, with the addition of vague streaks and spots on the upper portion of the spire. This is very close to the pattern of *A. sinensis* var. *gracilis* Fulton, 1896 from Pegu, Burma, which may be a form of *A. areolatus*. The *gracilis* of Fulton is stated to have four rows of spots on the upper spire, while the Tale Sap shells have irregular blotches (pl. 1, fig. 5). The three measurable

adults are, respectively, 25.0, 23.2 and 23.0 mm. high; h/d ratio 1.91, 1.86 and 1.77; with 6, 5⅞, and 5¾ whorls.

3. Three shells from Nong Khor (USNM 363620), southeast Thailand, have the spotting and streaking intensified and extending onto the body whorl. However, the basal banding is absent in one, the second is the same as in number 2, and the upper band is split into two on the third. There is no trace of a columellar color patch. They are 23.4–26.1 mm. high, h/d ratio 1.89–1.96, whorls 6 to 6¾.

4. A single adult from Krabin (USNM 363621), central Thailand, has a reddish columellar suffusion, the columellar bands replaced by a row of spots, a yellow subsutural band, and rather reddish brown radial blotches that do not reach the suture (pl. 1, fig. 6). It is 25.2 mm. high, h/d ratio 2.03 with 6⅞ whorls.

5. A worn adult from Sriracha (USNM 405892), southeast Thailand, has the purplish-brown basal bands, and longer, more widely spaced radial streaks.

6. A juvenile shell from Nong Vang (USNM 384158a), southeast Thailand, has the color pattern, including reddish patch, of the type figures of *A. areolatus*. The only change from the type "5" is the angle of the radial streaks.

7. Specimens from Pak Jong, (USNM 365464, USNM 405908), eastern Thailand, Hoi Yang (USNM 420291), near Sriracha, southeastern Thailand, and Tha Lo (USNM 419193), Peninsular Thailand, show minor variations of yet another color pattern. They have the reddish columellar patch, two basal bands (becoming obsolete on one Pak Jong juvenile), and reddish to purple radial markings of the above forms, but differ in possessing a peripheral spiral yellow band (pl. 1, fig. 7) that stands in sharp contrast to the whitish background between the radial streaks. The radial streaks may be narrow, wide, crowded, or widely spaced.

A worn shell from Koh Samet (USNM 384154a), an island in the Gulf of Siam, Southeast Thailand, could not be referred to any color variety.

Amphidromus semitessellatus (Morlet, 1884)

Plate 2 (figs. 2–6)

Bulimus (*Amphidromus*) *semitessellatus* Morlet, 1884, Journ. de Conch., vol. 32, pp. 387–388, pl. 11, figs. 2, 2a [Laos].

Amphidromus semitessellatus (Morlet).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 564.

Specimens from Sam Roi Yot (USNM 420457, USNM 420458) and Nakon Sritamarat (USNM 419814) in Peninsular Thailand and Srakeo (USNM 419811), southeast Thailand, are tentatively grouped under this name. Size variation in the Sam Roi Yot specimens is summarized in table 1.

Color variation is considerable. The types had a subsutural black or purplish band and the upper spire a series of brownish spots. The body whorl was pale or with subperipheral spiral bands of purple or black. The Sam Roi Yot examples (pl. 2, figs. 3–6) show a wide range of patterning, with yellow, purple, or no subsutural bands, with spots or heavy streaks and sometimes with a yellow green periderm. Basal bands are present on one specimen. The single shell from Srakeo (pl. 2, fig. 2) has an even more modified pattern on the lower whorls with the streaks narrowed, reddish brown, short, and widely spaced. The specimens from Nakon Sritamarat (28.2 mm. high) and Srakeo (31.2 mm. high) are much smaller than the Sam Roi Yot specimens. A juvenile shell from Pran (USNM 419815), Peninsular Thailand, probably belongs to this species.

Amphidromus xiengensis Morlet, 1891

PLATE 2 (FIGS. 7–13)

Amphidromus xiengensis Morlet, 1891, Journ. de Conch., vol. 39, pp. 27, 232, 240–241, pl. 5, fig. 4 [Xieng Moi Plateau, Laos].—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, pp. 564–565.

Five color forms could be distinguished in the material examined:

1. Form *xiengensis* (pl. 2, fig. 10) has the radial streaks interrupted by a single spiral yellow zone and has the streaking continued to (or near to) the aperture. A single adult (37.6 mm. high with 7 whorls) from Chiengmai (USNM 420267), North Thailand, is atypical only in having the radial streaking greatly reduced on the last part of the body whorl as in many examples of form *clausus*.

2. Form *multifasciatus* Fulton, 1896, has the radial streaks interrupted by several spiral yellow bands with the streaks continuing to the aperture. No adequately localized material of this variation was seen, although the specimen cataloged as USNM 522371, received from Fulton, is possibly a paratype.

3. From *clausus* Pilsbry, 1900, has the patterning obsolete at least on the last part of the body whorl, several spiral bands interrupting the radial flames, and a distinctive buff-yellow tone to the portion of the shell without radial pattern. Numerous specimens were seen from Chiengdao (USNM 419906, USNM 420330, USNM 420331, USNM 420333) and Doi Hua Mot (USNM 527275) at 1,000 meters elevation in North Thailand. Size variation is summarized in table 1. The umbilicus varies from narrowly to widely open. Of 20 adult shells from Chiengdao, 5 have most or all of the radial pattern reduced or absent, 4 have very little pattern reduced, and the remaining have one or two whorls without radial patterning (pl. 2, figs. 11–13).

4. Material from Kao Sabab at 300 (USNM 427324), 500 (USNM 427336), and 600 (USNM 427316) meters and Kao Bantad near Krat (USNM 405858a) in Southeast Thailand represent an unnamed color variation that differs in lacking the red subsutural band and in having the radial streaks broadened on the last whorl, which is usually darker in tone than the preceeding ones (pl. 2, figs. 7–8). It is thus the opposite of the *clausus* variation where the last whorl is much lighter than the preceding ones. Two of the thirteen specimens, however, are yellow with only a single reddish spiral band on the body whorl midway between the umbilicus and the periphery. The Kao Sabab shells are slightly smaller than those of the Chiengdao population (see table 1), and the population may be subspecifically distinct. Nomenclatural recognition would be premature, since so little material is available of this species.

5. Two shells from Kao Pae Nam, Lomsak (USNM 427295), Central Thailand, are doubtfully referred here. The slightly worn adult (pl. 2, fig. 9) has a reddish subsutural line, a red suffusion around the columella, no basal bands, broad wavy flames on the first half of the body whorl with the last half monochrome. On the upper whorls the radial streaks are bisected or trisected above the periphery, partially to completely fused below. The shell is slender (31.0 mm. high, h/d ratio 2.13, with 6⅞ whorls) and approached the *A. semitessellatus* and *A. xiengensis* variations in size and patterning. Its identity is uncertain.

Amphidromus fultoni Ancey, 1897

Amphidromus fultoni Ancey, 1897, Nautilus, vol. 11, pt. 6, pp. 62–63 [Cochin, China].—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 565.

A juvenile shell from Koh Prab near Bandon (USNM 361454), Peninsular Thailand, has the same color pattern shown in the type figures. More adequate collections may show that *fultoni* is only a color phase of another species.

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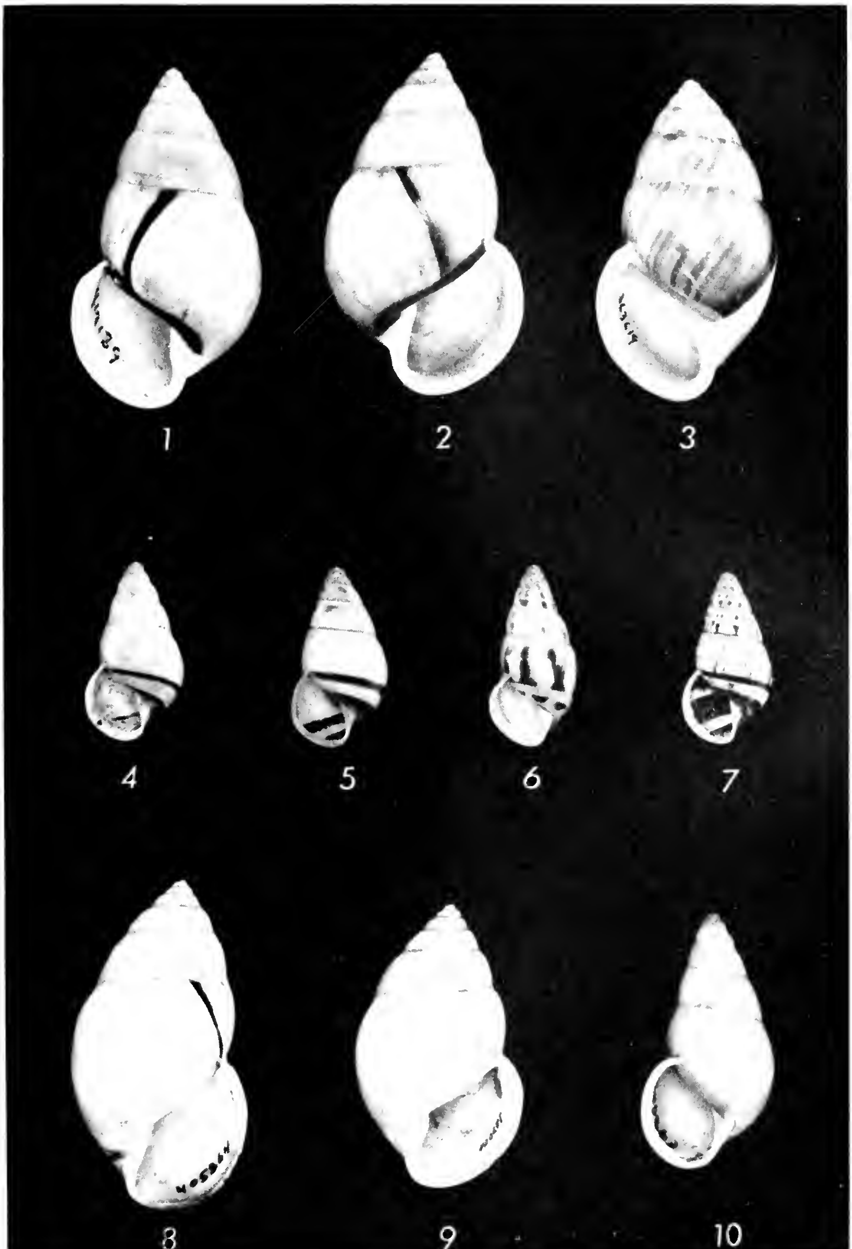
Plate 1

Figures 1–10.—*Amphidromus atricallosus* (Gould): 1 (USNM 419189), typical form, from Kao Luang, west of Nakron Sritamarat, Peninsular Thailand; 2 (CNHM 109473), variant form with slight brownish suffusion, from Khao Luang, west of Prachuab Kirikhan, West Thailand; 3 (USNM 363619), form *laidlawi*, new form, holotype, from Nong Khor, Southeast Thailand. *Amphidromus areolatus* (Pfeiffer): 4 (USNM 427307), color form 1, from Kao Chong, Peninsular Thailand; 5 (USNM 361448), color form 2, from Tale Sap, Peninsular Thailand; 6 (USNM 363621), color form 4, from Krabin, Central Thailand; 7 (USNM 419193), color form 7, from Tha Lo, Peninsular Thailand. *Amphidromus atricallosus* (Gould): 8 (USNM 405864), form *leucoxanthus* von Martens, from Lem Sing, Chantabun, Eastern Thailand; 9 (USNM 420288), form *perakensis* Fulton, from Hoi Yang, near Sriracha, Southeast Thailand. *Amphidromus sinensis indistinctus* Pilsbry: 10 (USNM 405863), from Ban Nam Kien, North Thailand.



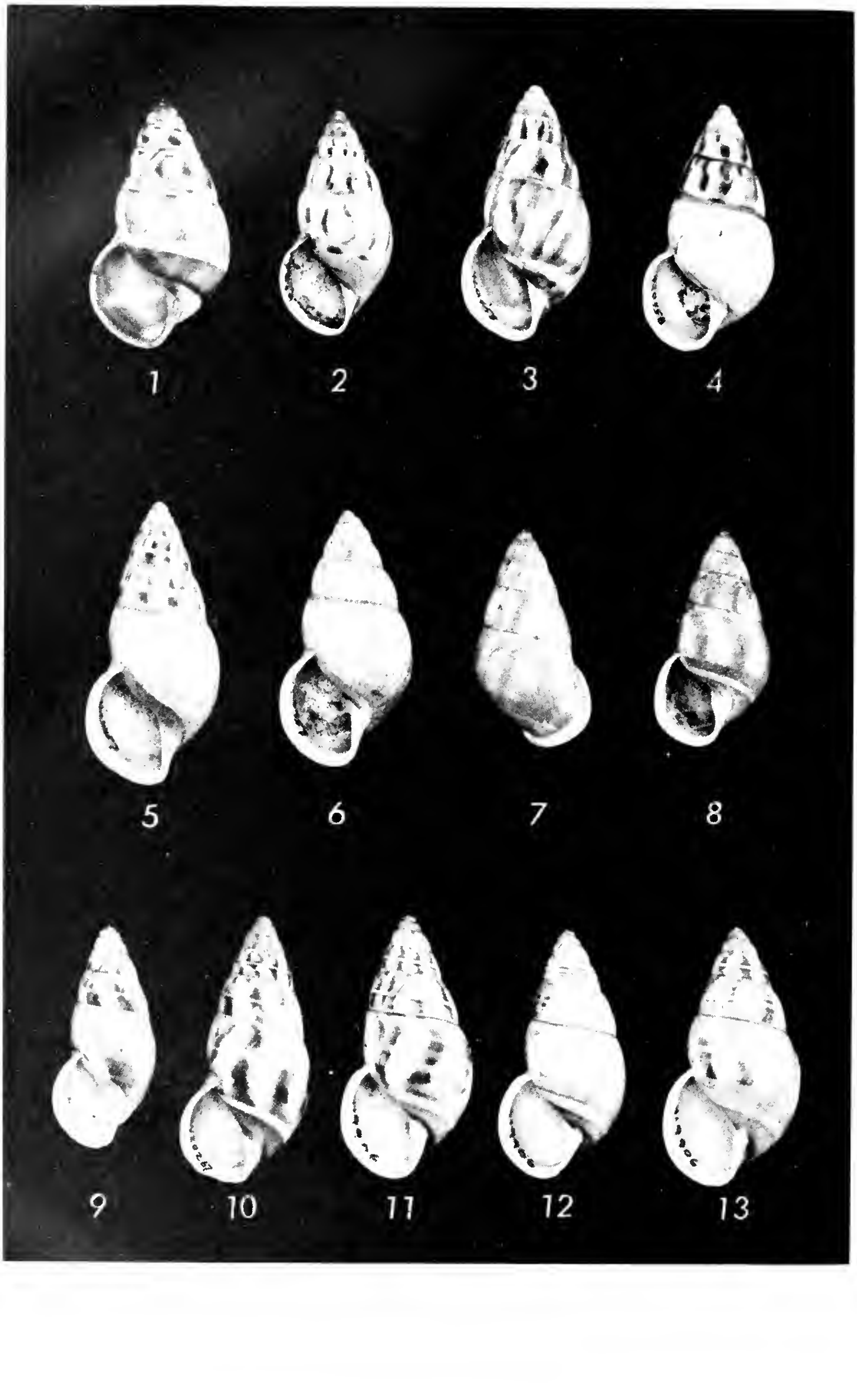


Plate 2

Figures 1–13.—*Amphidromus glaucolarynx* (Dohrn): 1 (USNM 427382), form *fasciatus* von Martens, from Wang Kien, Central Thailand. *Amphidromus semitessellatus* Morlet: 2 (USNM 419811), an unnamed color form showing reduction of the stripes, from Srakeo, Southeast Thailand; 3–4 (USNM 420458), color forms from Sam Roi Yot, Peninsular Thailand; 5–6 (USNM 420457), color forms from another set from Sam Roi Yot, Peninsular Thailand. *Amphidromus xiengensis* Morlet: 7–8 (USNM 427324), unnamed color form from 300 meters elevation at Kao Sabab, Southeast Thailand; 9 (USNM 427295), unnamed color form from Kao Pae Nam, Lomsak, Central Thailand; 10 (USNM 420267), typical color form, from Chiengmai, North Thailand; 11–13 (USNM 419906), form *clausus* Pilsbry, from Chiengdao, North Thailand, showing variation in reduction of the color pattern.

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A REVIEW OF THE GENUS HAIMBACHIA DYAR WITH DESCRIPTIONS OF NEW SPECIES (LEPIDOPTERA: CRAMBIDAE)

By HAHN W. CAPPS [1]

The purpose of this paper is threefold: to redefine the moth genus *Haimbachia;* to correct several errors in the Dyar and Heinrich treatment in 1927 (Proc. U.S. Nat. Mus., vol. 71, pp. 32–37); and to provide names for some undescribed species represented by material that has been in the collection of the U.S. National Museum for many years.

All of the illustrations were prepared by Mr. A. D. Cushman, scientific illustrator of the U.S. Department of Agriculture, except figures 1–2b, 6–9, and 25–30, which are those drawn by Miss E. T. Armstrong and used in the Dyar and Heinrich paper of 1927. All of the male genitalia are shown with the aedeagus removed and some with the left harpe, vinculum, gnathos, and uncus also removed. The figures with the vinculum are in ventral view; those of the removed left harpe depict a lateral view of the inner surface, and all of the aedeagi are in lateral view. In the female genitalia, the ovipositor and collar of the eighth segment are shown in lateral view; the ventral tonguelike projection from the collar and seventh segment are shown somewhat flattened to give a ventral or three-quarter view of the distal end of the projection and genital opening, but there are a few exceptions.

[1] Entomology Research Division, Agriculture Research Service, U.S. Department of Agriculture, Washington, D.C.

Genus *Haimbachia* Dyar

Haimbachia Dyar, 1909, Proc. Ent. Soc. Washington, vol. 11, pp. 28–29.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 140.—Forbes, 1920, Journ. New York Ent. Soc., vol. 28, p. 221; [1924], Cornell Univ. Agric. Exp. Sta. Mem. 68, p. 593.—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, pp. 32–33.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 25.

Type: *Crambus placidellus* Haimbach, original designation.

Frons round or conical. Ocelli present. Labial palpi long, porrect, slightly down curved, extending over twice the length of the head. Antennae simple, slightly thickened in male. Venation: Forewing with 3 from before angle of cell; 4 and 5 separate, from the angle; 6 from below apex of cell; 7 from apex; 8 and 9 long stalked; 10 free and from cell, near stalk of 8 and 9; 11 anastomosing with 12. Hindwing with 4 and 5 approximate at origin, thence divergent; 6 from apex of cell with 7; 7 anastomosing shortly with 8.

Male genitalia: Uncus stout, short, with apex rounded and a short, subapical spur beneath. Gnathos short, stout, with a median, short, upcurved hook. Vinculum greatly enlarged, oblong or approximately square and usually with the ventral margin incurvate. Harpe divided, upper element a strongly sclerotized basal costal lobe, usually with a hooklike production.

Abdomen of male without tufts on second segment.

Female genitalia: Ductus bursae moderately long, not coiled, conspicuous sclerotization, not extending beyond origin of ductus seminalis. Bursa copulatrix elongate or ovoid, with or without signa. Posterior apophyses conspicuously dilated. Collar of eighth segment with a tonguelike projection from anterior ventral margin and curving back behind genital opening.

Remarks: Most *Haimbachia* species can be recognized by the maculation of the forewing (fig. 14). The upper surface has a white or grayish ground color irrorated with brown or fuscous. The facies of most of the species is whitish or grayish, but those with the intense brown irroration are brownish in appearance. Between the termen and base of the wing are two complete transverse markings and a short incomplete one about midway between them. The inner marking is a single line, yellow or brownish, with its origin near the middle of the costa, that passes obliquely outward a short distance and then curves outward to form a loop enclosing the cell, thence straight or sinuate to the inner margin. The outer marking has the appearance of a narrow band with the central area concolorous with the ground color of the wing and the margins defined by a greater intensity of the irroration.

In the descriptions which follow, the inner marking is referred to as the medial line; the outer one, as the subterminal band; and the short line between them, as the postmedial oblique bar.

The under surface of the wings is concolorous with the ground color of the upper surface, somewhat suffused with ochreous or brown and the suffusion usually stronger on the forewing but without conspicuous or characteristic markings; to avoid needless repetition, treatment of it is omitted in the descriptions herein.

Key to Species of *Haimbachia* Based on Habitus, Coloration, and Structure of the Frons

1. Frons cone shaped 2
   Frons round 9
2. Fringe of forewing nonmetallic 3
   Fringe of forewing metallic 6
3. Medial line with origin anterior to middle of costa 4
   Medial line with origin from middle of costa 5
4. Medial line ochreous, terminating on inner margin of the wing at middle. **squamulella** (Zeller)
   Medial line brownish, terminating on inner margin of the wing anterior to middle . . . . **indistinctalis**, new species
5. Distribution: Sinaloa, Mexico . . . . **prestonella** Schaus
   Distribution: Arizona . . . . **arizonensis**, new species
6. Facies brownish 7
   Facies whitish; whitish with a slight ochreous tinge, or grayish 8
7. Conical production of frons strong. Forewing narrow, apex somewhat acuminate . . . . **maroniella** Dyar and Heinrich
   Conical production of frons weak. Forewing broader, apex not acuminate **dumptalis** Schaus
8. Forewing narrow, apex somewhat acuminate; medial line and margins of subterminal band brownish, obsolescent, barely discernible. **pallescens**, new species
   Forewing broader, not acuminate at apex; medial line and margins of subterminal band ochreous, definition weak but definable . **quiriguella** Schaus
9. Fringe of forewing metallic 10
   Fringe of forewing nonmetallic . . . . **diminutalis**, new species
10. Forewing with a small, fuscous, discocellular spot 11
    Forewing without a fuscous discocellular spot 13
11. Facies brownish. Inner margin of subterminal band of forewing not strongly angulate inward at vein 2 . . . . **discalis** Dyar and Heinrich
    Facies whitish or grayish. Inner margin of subterminal band of forewing strongly angulate inward at vein 2 12
12. Forewing narrow, somewhat acuminate at apex . . . **floridalis**, new species
    Forewing broader, not acuminate at apex . . . . . **albescens**, new species
13. Forewing with the medial line straight or nearly so . . . . **gloriella** Schaus
    Forewing with the medial line distinctly sinuate 14
14. Forewing whitish, with a slight ochreous tinge; medial line and margins of subterminal band rather broad, definition somewhat diffuse. **placidella** (Haimbach)
    Forewing whitish, without an ochreous tinge; medial line and margins of subterminal band narrow, definition not diffuse . **cochisensis**, new species

Key to Species of *Haimbachia* Based on the Male Genitalia

1. Harpes symmetrical 2
   Harpes asymmetrical 10
2. Vinculum with ventral margin straight . . **maroniella** Dyar and Heinrich
   Vinculum with ventral margin incurved 3
3. Aedeagus curved, hooklike at apex 4
   Aedeagus otherwise 5
4. Distal end of the hook truncate . . . . **gloriella** Schaus
   Distal end of the hook a sharp point . . . . . **discalis** Dyar and Heinrich
5. Distal projection of dorsal basal lobe round, slender 6
   Distal projection of dorsal basal lobe somewhat flattened, stout 8
6. Costal hook long, slender, knoblike at distal end . . . . **quiriguella** Schaus
   Costal hook otherwise 7
7. Costa of dorsal basal lobe triangularly produced. Aedeagus with a toothlike production from near middle of a long, straplike sclerotization. **placidella** (Haimbach)
   Costa of dorsal basal lobe round. Aedeagus without a toothlike production. **dumptalis** Schaus
8. Distal projection short, length not more than twice its width; apex truncate. **indistinctalis**, new species
   Distal projection otherwise 9
9. Dorsal basal lobe with a small, sharp, toothlike production on costal margin **albescens**, new species
   Dorsal basal lobe without a small, sharp, toothlike production on costal margin . . . . **floridalis**, new species
10. Uncus with two conspicuous, long, slender, modified setae at apex. **pallescens**, new species
    Uncus otherwise 11
11. Hook of right harpe curved serpentine-like. Aedeagus with a distal cluster of rather strong spinules . . . . **squamulella** (Zeller)
    Hook of right harpe with curvature otherwise. Aedeagus without a cluster of spinules 12
12. Hook of right harpe with dilation near middle distinctly angulate. Aedeagus long, slender, undulate; width at apex distinctly less than at base. **diminutalis**, new species
    Hook of right harpe with dilation near middle, rounded. Aedeagus shorter and stouter than above, straight or nearly so and width at apex and base approximately equal 13
13. Hook of right harpe broadly expanded basally; distal part straight or nearly straight, stout and bluntly pointed. . . . . **prestonella** Schaus
    Hook of right harpe not so broadly expanded basally; distal part distinctly curved, more slender and more sharply pointed than above. **arizonensis**, new species

Key to Species of *Haimbachia* Based on the Female Genitalia

1. Signum or signa present 3
   Otherwise 2
2. Tonguelike projection with median area of the bifurcation angulate, acute and rather deep; the projection divided, slitlike from base of bifurcation to near the loop . . . . **diminutalis**, new species
   Tonguelike projection with median area of bifurcation broadly concave; the projection undivided from base of bifurcation to the loop. **pallescens**, new species

3. With a single signum 4
   With two signa 5
4. Signum short, stout, spinelike . . . . **discalis** Dyar and Heinrich
   Signum long, narrow, thin, wedgelike . . . . **floridalis,** new species
5. Signa small, round, inner surface with minute spinules 6
   Signa otherwise 8
6. Tonguelike projection not bifurcate above ventral margin of the ostium. **maroniella** Dyar and Heinrich
   Tonguelike projection distinctly bifurcate above ventral margin of the ostium 7
7. Ductus bursae rather strongly sclerotized from ostium to near origin of ductus seminalis, the sclerotization conspicuously constricted near middle . . . . **dumptalis** Schaus
   Ductus bursae not as above . . . . **placidella** (Haimbach)
8. Signa distinctly subequal, the large signum narrow, elongate, wedgelike . 9
   Signa otherwise 10
9. Tonguelike projection with median area of bifurcation broadly concave . . . . **gloriella** Schaus
   Tonguelike projection with median area of bifurcation strongly angulate, apices blunt . . . . **albescens,** new species
10. Signa rather large, slender and thornlike; length of the spine approximately two times the diameter of its base . . . . **quiriguella** Schaus
   Signa much shorter, spinelike or subconical 11
11. Ductus bursae with accordion-like folds from ostium to the loop and distinctly tapered from ostium to the loop . . . . **squamulella** (Zeller)
   Ductus bursae not as above 12
12. Ventral margin of ostium with a median finger-like production. Signa subconical, bluntly pointed . . . . **cochisensis,** new species
   Ventral margin of ostium without a median finger-like production. Signa sharply pointed, spinelike 13
13. Tonguelike projection with median area of bifurcation acutely angulate, rather deep . . . . **prestonella** Schaus
   Tonguelike projection with median area of bifurcation broadly concave . . . . **arizonensis,** new species

Haimbachia squamulella (Zeller)

Figures 8, 14, 30

Chilo squamulellus Zeller, 1881, Hort. Ent. Soc. Ross., vol. 16, p. 158.—Fernald, 1896, Cramb. North America, Spec. Bull. Massachusetts Agric. Col., p. 79; 1903, *in* Dyar, U.S. Nat. Mus. Bull. 52, no 4630 (list).

Platytes squamulella (Zeller).—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, no. 5426.

Haimbachia squamulella (Zeller).—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 35.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 25, no. 5967.

Alar expanse: Male 13–18 mm.; female 14–23 mm.

Frons strongly conical. Head and body white. Palpi whitish with intermixture of brownish fuscous laterally and near tips. Abdomen whitish, ochreous dorsally, the ochreous stronger anteriorly. Forewing: Upper surface whitish, irrorated with brown and fuscous; the

brown predominate from base of wing to medial line and the fuscous, between medial line and subterminal band. Medial line buff, origin before middle of costa, strongly oblique outward to vein 7, the loop narrow and extending well beyond end of cell, zigzag or strongly sinuate from outer angle of cell to inner margin of wing, terminating near or slightly beyond middle. Postmedial oblique bar subparallel with and extending to inner margin of subterminal band. Subterminal band with central area white; origin about one-fifth the length of costa before apex; inner margin narrow, buff, angulation of indentation at vein 2, obtuse; outer margin narrow, buff from costa to vein 6, remainder fuscous, indentation at vein 2 weaker than that of inner margin. Fringe nonmetallic. Hindwing: Upper surface whitish, subterminal line, if discernible, ochreous, obsolescent from vein 2 to inner margin.

Male genitalia (figs. 8, 8a): Asymmetrical. Aedeagus somewhat enlarged distally and enlargement bearing a cluster of rather strong spinules.

Female genitalia (fig. 30): The tonguelike projection bifurcate, median area of bifurcation acutely angulate. Ventral margin of ostium straight. Ductus seminalis originating about midway between ostium and junction of ductus bursae and bursa copulatrix. Ductus bursae sclerotized from ostium to near origin of ductus seminalis and with conspicuous longitudinal grooves anteriorly. Two signa, similar; each a short, stout, conical projection from a small round base.

Type: In the British Museum (Natural History).

Type locality: Bosque Co., Texas.

Food plant: Unknown.

Distribution: New Jersey, District of Columbia, North Carolina, Tennessee, Georgia, Florida, and Texas.

Remarks: Character of the frons and medial line of the forewing and lack of a discocellular fuscous patch are diagnostic for *squamulella.* In *squamulella,* the frons is conical; the medial line ochreous with origin before the middle of costa and the loop narrow, extending well beyond the end of the cell. No other species without a discocellular fuscous patch has this combination of characters.

Haimbachia prestonella Schaus

Figures 9, 27

Haimbachia prestonella Schaus, 1922, Proc. Ent. Soc. Washington, vol. 24, p. 138.—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 35 [erroneously cited as a synonym of *H. quiriguella* Schaus].

Alar expanse: Male 12 mm.; female 17 mm.

Resembles *squamulella* but with the frons only moderately conical; forewing with origin of median line from middle of costa, and the loop enclosing the cell broad and extending but little beyond end of the cell;

both the inner and outer margins of the subterminal band with fuscous predominating from vein 6 to inner margin of the wing; indentation of the margins of subterminal band at vein 2, weak, broadly concave or but slightly angulate. Postmedial oblique bar parallel to anterior part of subterminal band, short, stout, not extending beyond stem of veins 7 and 8. Fringe nonmetallic. Female paler and definition of markings weaker than in the male.

Male genitalia (figs. 9–9b): Asymmetrical. Hook from dorsal basal lobe of left harpe, stout, curved, sharply pointed; that of right harpe, straight or nearly so and strongly dilated basally. Aedeagus not conspicuously expanded distally; distal half armed with numerous, fine spinules.

Female genitalia (fig. 27): The tonguelike projection strongly bifurcate, median area of the bifurcation deeply and acutely angulate. Ventral margin of ostium evenly curved, slightly convex, but no median production present. Two subequal signa, each a short, sharp spine from a small circular base.

Type: Male, in U.S. National Museum, USNM 25553.

Type locality: Venadio, Sinaloa, Mexico.

Food plant: Unknown.

Distribution: Known only from the type locality.

Remarks: Dyar and Heinrich (1927) erred in concluding that *prestonella* represented the male of *quiriguella* Schaus, and their synonymizing it under that species is incorrect. The series of *gloriella* Schaus, with the same type locality as *prestonella*, which they studied was a mixture. They did not dissect the type of *gloriella*, and unfortunately the specimen they selected and figured under their number 71 as *gloriella* is not that species but is the female of *prestonella*. The specimen has a conical frons, and the fringe of the forewing is nonmetallic; *gloriella* has a rounded frons, and the fringe of the forewing is metallic.

Haimbachia arizonensis, new species

FIGURES 12, 17

Alar expanse: Male and female 16 mm.

Frons conical. Fringe of forewing nonmetallic. Color and maculation similar to *prestonella* but definition of the markings usually weaker and reliably distinguishable from *prestonella* only by the genitalia.

Male genitalia (figs. 12–12b): Asymmetrical. Resembling those of both *squamulella* and *prestonella*, but more like the latter. In *arizonensis*, the vinculum is broader and the distal hooks of the harpes and the aedeagus are more slender than in *prestonella*.

Female genitalia (fig. 17): The tonguelike projection bifurcate, median area of the bifurcation broadly concave. Two signa, each a small, round sclerotization bearing a short, stout, spine.

Type: Male, in U.S. National Museum, USNM 65002.

Type locality: Baboquivari Mountains, Pima Co., Arizona.

Paratypes: Four males and two females, all from the type locality.

Food plant: Unknown.

Remarks: The female genitalia of *arizonensis* also resemble those of *squamulella* and *prestonella*, but the median area of the bifurcation is shallow and broadly concave in *arizonensis*; in *squamulella* and in *prestonella* it is distinctly acutely angulate and rather deep.

The ductus bursae is slightly damaged; a small part of it is missing in the illustration.

Haimbachia quiriguella Schaus

FIGURES 3, 29

Haimbachia quiriguella Schaus, 1922, Proc. Ent. Soc. Washington, vol. 24, p. 137.—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, pp. 34–35.—Swain, 1953, FAO, Plant Prot. Bull., vol. 1, p. 89.

Alar expanse: Male 16 mm.; female 18 mm.

Frons conical. Fringe of forewing metallic. Resembles *prestonella* in maculation but with irroration brown instead of fuscous and indentation of inner margin of the subterminal band at vein 2 deep and acute.

Male genitalia (figs. 3–3c): Symmetrical. Costal hook of harpe slender, curved, knoblike at distal end; production of costa of dorsal basal lobe narrow, triangulate. Aedeagus slender, with numerous small spinules and a distal serration of several small teeth.

Female genitalia (fig. 29): The tonguelike projection bifurcate, median area of bifurcation broadly angulate. Ventral margin of ostium straight or nearly so. Ductus bursae much shorter than bursa copulatrix; origin of ductus seminalis distinctly closer to loop of the tonguelike projection than to junction of ductus bursae and bursa copulatrix. Bursa copulatrix elongate and with two large, thornlike signa.

Type: Female, in U.S. National Museum, USNM 25552.

Type locality: Quirigua, Guatemala.

Food plant: Rice.

Distribution: Guatemala, Nicaragua, and Costa Rica.

Remarks: See comments under *prestonella* regarding the erroneous association of that species as male of *quiriguella*. The specimen treated here as the male of *quiriguella* was reared by Dr. R. B. Swain from larvae feeding in rice in Nicaragua and is associated with females which agree in both maculation and genitalia with the type of

quiriguella. H. prestonella appears to be a more northern species and restricted to Mexico.

***Haimbachia pallescens*, new species**

FIGURES 4, 21

Alar expanse: Male and female 18 mm.

Frons conical. Head and thorax white, with some intermixture of yellowish brown. Palpi white, mixed with pale fuscous. Forewing: Upper surface white, irrorated with brown, the irroration extending to or almost to termen. The transverse markings weak and poorly defined; medial line very narrow, brownish; origin from middle of costa, strongly oblique outward to vein 7, loop enclosing end of cell, broad, strongly inward from outer angle of cell to slightly below origin of vein 2, outward to about middle of vein 2, thence oblique inward to inner margin of the wing, terminating near middle. Subterminal band poorly defined, origin about one-fifth the length of costa before apex, oblique outward to about vein 6 and almost to termen; inner margin of the band strongly zigzag from vein 3 to inner margin, terminating slightly before tornus; obsolescent in intervening area. The indentation of inner margin at vein 2 deep and acute. Terminal line narrow, weakly discontinuous, with two or three small fuscous patches between veins 1b and 3. Fringe of forewing metallic. Hindwing: Upper surface white, lustrous; fringe white.

Male genitalia (figs. 4, 4a): Asymmetrical. Hooklike production of dorsal basal lobe of left harpe long, slender, distal end a sharp point; similar structure of right harpe shorter and conspicuously enlarged basally. Uncus with two long, modified distal setae. Aedeagus long, slender, somewhat narrower distally and without cornutus.

Female genitalia (fig. 21): The tonguelike projection bifurcate, median area of bifurcation broadly concave. Ventral margin of ostium with a median triangular production. Ductus seminalis origin about midway between ostium and junction of ductus bursae with bursa copulatrix. No signum.

Type: Male, in U.S. National Museum, USNM 65003.

Type locality: Redington, Arizona.

Paratype: One female from the type locality.

Food plant: Unknown.

Remarks: The conical frons in combination with the narrow medial line, poor definition of both the medial line and subterminal band, and more extensive irroration, this extending to or almost to the termen, will distinguish *pallescens* from all other species of the group. The two conspicuous, modified distal setae of the uncus are diagnostic for the male genitalia of *pallescens;* the broadly concave bifurcation of the tonguelike projection, in combination with the triangulate median

production of the ventral margin of the ostium and lack of a signum are characteristic of the females.

Haimbachia indistinctalis, new species

FIGURE 11

Alar expanse: Male 18 mm.

Frons moderately conical. Head, palpi, and thorax sordid white with intermixture of smoky fuscous. Forewing: Upper surface whitish, rather densely irrorated with fuscous or buff, the irroration absent on veins. The two transverse markings poorly defined; medial line cinnamon brown, origin from or slightly before middle of costa, sharply outward to stalk of veins 8 and 9, loop enclosing the cell broad and extending well beyond end of cell, from outer angle of cell approximate to lower margin of the cell and inward to origin of vein 2, thence oblique inward and terminating on inner margin at about one-third its length from base of wing. Subterminal band with central area and outer margin rather poorly defined; origin from costa about three-fourths length of costa from the base; inner margin evenly curved outward to vein 7, posteriorly to vein 5, obliquely inward to veins 2 and 1b, thence obliquely inward and terminating on inner margin slightly before tornus. A small blackish patch on discocellular between veins 4 and 5. Terminal line discontinuous, the dots fuscous. Fringe nonmetallic. Hindwing: Upper surface white, with a narrow, buff, terminal line.

Male genitalia (figs. 11–11c): Symmetrical. Dorsal basal lobe of harpe broad basally, narrower and rounded distally, costal margin undulate; the hooklike projection short, stout, rather truncate distally. Aedeagus with one or two weak, slender cornuti and numerous minute spinules.

Type: Male, in U.S. National Museum, USNM 65004.

Type locality: Brownsville, Texas.

Paratype: One male, Kerrville, Texas.

Food plant: Unknown.

Remarks: In general appearance, *indistinctalis* resembles *pallescens* but differs in being duller, the forewing less acuminate, the transverse lines darker, the fringe metallic and having a conspicuous discocellular fuscous patch.

The female is unknown.

Haimbachia dumptalis Schaus

FIGURES 2, 25

Haimbachia dumptalis Schaus, 1922, Proc. Ent. Soc. Washington, vol. 24, p. **137**—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 36.

Alar expanse: Male 16 mm.; female 15 mm.

Frons weakly conical. Head, thorax, and palpi white, with a pale ochreous tinge; the palpi with intermixture of fuscous distally. Abdomen whitish buff with basal segments ochreous dorsally. Forewing: Upper surface ground color white, with a pale ochreous or buff tinge, irrorated with brownish fuscous, the irroration rather intense. Medial line buff, definition weak; origin from slightly before middle of costa, oblique outward to vein 7, loop enclosing the cell broad and extending well beyond end of cell, angled inward and outward between cell and vein 2, thence slightly sinuate and oblique inward, terminating at or slightly before middle of inner margin of the wing. Postmedial oblique bar buff, subparallel to and extending to inner margin of subterminal band. Subterminal band with origin from costa about one-fifth length of wing before apex, slightly oblique from costa to vein 6, remainder broadly curved and subparallel to termen; central area white, inner and outer margins brownish, with little or no indentation at vein 2. Terminal line discontinuous, fuscous patches small. Fringe metallic. Facies brownish. Hindwing: Upper surface ochreous white, with an indistinct double subterminal line, buff, extending from costa to vein 2; terminal line single, buff. Fringe gray, tipped with buff.

Male genitalia (figs. 2–2b): Symmetrical. Dorsal basal lobe of harpe with costa broadly rounded, hook from the lobe slender, slightly curved, undulate, not enlarged distally. Vinculum elongate, ventral margin deeply incurvate. Aedeagus with numerous spinules; somewhat bifid distally, the two straplike sclerotizations subequal.

Female genitalia (fig. 25): The tonguelike projection bifurcate, angulation of median area of the bifurcation obtuse or nearly so. Ventral margin of ostium rounded, convex. Ductus bursae sclerotized from ostium to origin of ductus seminalis, constricted near middle. Signa two small, round, slightly convex and scobinate, weakly sclerotized areas.

Type: Male, in U.S. National Museum, USNM 25550.

Type locality: Cayuga, Guatemala.

Food plant: Unknown.

Remarks: Only two species with a conical frons, *dumptalis* and *maroniella*, have brownish facies. See remarks under the latter for distinguishing characters of habitus. The male genitalia of *dumptalis* resemble those of *placidella* and *quiriguella*, but in both *placidella* and *quiriguella* the costa of the basal dorsal lobe is triangularly produced; in *dumptalis*, it is broadly rounded, with no conspicuous production. The female genitalia of *dumptalis* are somewhat similar to those of *placidella* and *squamulella*, but the ductus bursae of *dumptalis* is distinctly constricted about midway between the ostium and origin

of the ductus seminalis; the ductus bursae of *placidella* and *squamulella* are without such a constriction.

Haimbachia maroniella Dyar and Heinrich

FIGURES 6, 26

Haimbachia maroniella Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 36.

Alar expanse: Male 15 mm.; female 15–17 mm.

Frons strongly conical. Maculation and coloration as in *dumptalis*, but with the forewing narrower and more acuminate.

Male genitalia (figs. 6–6b): Symmetrical. Dorsal basal lobe broadly rounded distally, costal margin with a toothlike projection near middle; hook from the lobe short, stout, enlarged basally. Vinculum conspicuously tapering ventrad, ventral margin straight. Aedeagus with no well-developed cornutus, but with numerous small spinules.

Female genitalia (fig. 26): The tonguelike projection short, weakly bifid distally but not free, rounded and fused with ductus bursae at ostium. Ventral margin of ostium obtusely angulate. Ductus bursae long, slender, weakly sclerotized, longitudinally rugose and with minute spinules from ostium to or almost to origin of ductus seminalis. Signa two small, round, slightly convex, weakly scobinate sclerotizations.

Type: Male, in U.S. National Museum, USNM 29435.

Type locality: "Sixty miles up the Maroni River," French Guiana.

Food plant: Unknown.

Distribution: Known only from the type locality.

Remarks: No consistent differences were noted in color and maculation for the separation of *dumptalis* and *maroniella*, but the strong conical frons and more acuminate forewing of *maroniella* readily distinguish specimens of it from those of *dumptalis*. The tapering vinculum with the straight ventral margin is diagnostic for the male genitalia of *maroniella* and separates them from those of all other known species of the genus; the short, unforked, ventral, tonguelike projection and medial obtuse angulation of the ventral margin of the ostium is similarly diagnostic for the female genitalia.

Haimbachia discalis Dyar and Heinrich

FIGURES 10, 28

Haimbachia discalis Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 37.

Alar expanse: Male 14–18 mm.; female 15–19 mm.

Frons round. Facies brownish. Fringe of forewing metallic. Color and maculation similar to *dumptalis* and *maroniella*, but with

the forewing less acuminate than *maroniella*, more like *dumptalis*, but with a conspicuous fuscous discocellular patch between veins 5 and 6 which is absent in both *dumptalis* and *maroniella*.

Male genitalia (figs. 10, 10a): Symmetrical. Dorsal basal lobe somewhat triangular in shape, inner margin with a small, toothlike projection near middle; distal costal hook curved, sharply pointed; greatly enlarged basally. Aedeagus with termination of distal hook sharply pointed.

Female genitalia (fig. 28): The tonguelike projection bifurcate with apices sharply pointed, median area of bifurcation broadly concave or weakly angulate. Sclerotized part of ductus bursae short, not extending below loop of the tonguelike projection. Signum a single, strong spine.

Type: Male, in U.S. National Museum, USNM 29436.

Type locality: Jalapa, Mexico.

Food plant: Unknown.

Distribution: Jalapa and Orizaba, Mexico; Brownsville and San Benito, Tex. (new record for U.S.).

Remarks: The round frons and fuscous discocellular patch of *discalis* readily distinguish it from *dumptalis* and *maroniella*.

Dyar and Heinrich did not figure the male genitalia of *discalis*, but stated: "Male genitalia as in *gloriella* Schaus." This, however, is incorrect and must have been due to a *lapsus* or confusion of material. I have dissected the genitalia of the type of *discalis* and five other males and compared them with those of the paratype on which their statement was based, and the aedeagi of all have the distal hook sharply pointed and not truncate, as in *gloriella*. The vinculum and anellus of *discalis* are also narrower and the uncus more compressed dorso-laterally and spatulate in shape than in *gloriella*.

The large single, stout, spinelike signum of *discalis* distinguishes the female genitalia of it from those of all others of the genus.

Haimbachia floridalis, new species

Figures 13, 28

Alar expanse: Male 16 mm.; female 14 mm.(?).

Frons round. Forewing: Somewhat acuminate. Upper surface whitish, moderately irrorated with fuscous or buff. Medial line with origin from or near middle of costa, strongly oblique outward to stem of veins 8 and 9, loop enclosing the cell extending but little beyond end of cell, zigzag from near end of cell to middle of inner margin of the wing. Subterminal band with indentation of inner margin at vein 2 deep and acute; that of outer margin also angulate but weaker, obtuse or nearly so. A small fuscous patch on discocellular vein between 5

and 6. Fringe metallic. Hindwing: Upper surface whitish; terminal line narrow, buff, definition weak.

Male genitalia (figs. 13–13b): Symmetrical. Projection from dorsal basal lobe straplike, distal curvature broad, pointed. Aedeagus stout, with a short, stout tooth and numerous minute spinules.

Female genitalia (fig. 22): The tonguelike projection bifurcate with apices blunt; median area of the bifurcation deeply and acutely angulate. Signum a long, narrow, wedgelike sclerotization.

Type: Male, in U.S. National Museum, USNM 65005.

Type locality: Everglades, Florida.

Paratype: One female, Sugar Loaf Key, Florida.

Food plant: An unidentified species of Gramineae.

Remarks: The whitish facies and deep indentation of the subterminal band at vein 2 of *floridalis* distinguish it from *discalis*, which also has a conspicuous fuscous discocellular patch but has a brownish facies and the indentation of the subterminal band at vein 2 much weaker.

The female paratype was reared, but it is deformed and its condition is too poor for accurate determination of the alar expanse.

Haimbachia albescens, new species

Figures 15, 23

Alar expanse: Male 18 mm.; female 18–20 mm.

Frons round. Fringe of forewing metallic. Like *floridalis* in color and maculation but larger, with the forewings less acuminate; separable from it by distribution and genitalic structures.

Male genitalia (figs. 15, 15a): Symmetrical. Apex of dorsal basal lobe rather narrow and triangular in shape; costal margin of lobe with a toothlike projection near middle; the hooklike projection from the lobe narrow, truncate distally and with a rounded production from near base. Aedeagus with one rather short, stout spine and numerous minute spinules.

Female genitalia (fig. 23): The tonguelike projection bifurcate, apices rather short, stout, blunt; median area of the bifurcation broadly angulate. Two signa, one a long, narrow, wedgelike, sclerotization and the other small, short, sharp, spinelike.

Type: Male, in U.S. National Museum, USNM 65006.

Type locality: Sioux City, Iowa.

Paratypes: One male and three females from type locality. One male and one female, Anglesea, New Jersey. One female, Cape Henry, Virginia.

Food plant: Unknown.

Remarks: The male genitalia of *albescens* resemble those of *floridalis*, but in the latter the production of costa of the dorsal basal lobe is broader apically, without a toothlike projection near middle of the

margin, and the hooklike projection from the lobe is without a rounded production near the base, and the distal end is more curved and sharply pointed than in *albescens*. The presence of two signa and the stouter tonguelike projection in the female genitalia of *albescens* distinguish them from those of *floridalis* which have but one signum and the tonguelike projection distinctly shorter and narrower.

Haimbachia gloriella Schaus

Figures 7, 24

Haimbachia gloriella Schaus, 1922, Proc. Ent. Soc. Washington, vol. 24, p. 137.—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 34.

Alar expanse: Male 15 mm.; female 15–17 mm.

Frons round. Head sordid white, frons and vertex with two small fuscous patches; palpi grayish, intermixed with fuscous. Thorax and patagia white, sprinkled with fuscous. Forewing: Upper surface whitish, irrorated with brownish fuscous, the irroration denser and finer from medial line to subterminal band; interspace of veins conspicuously ochreous from subterminal band to termen below vein 7; irroration absent on veins, giving the wing a lined appearance. Medial line brownish or fuscous from costa to vein 10, remainder ochreous; origin from middle of costa, oblique outward to vein 7, thence straight or nearly so posteriorly to inner margin of the wing, terminating slightly beyond middle. Postmedial oblique bar and margins of the subterminal band brownish; inner margin of the band only slightly incurved between veins 4 and 1b. Terminal line black, discontinuous, as small patches. Fringe metallic. Hindwing: Upper surface sordid white with buff suffusion; terminal line fuscous, extending from apex to about middle of outer margin; subterminal line brownish, parallel to outer margin. Fringe white.

Male genitalia (figs. 7–7b): Symmetrical. Aedeagus with termination of distal hook distinctly truncate.

Female genitalia (fig. 24): The tonguelike projection bifurcate, apices short, bluntly pointed; median area of bifurcation shallow, broadly concave. Two signa, one rather long and narrow, the other short, sharp, spinelike.

Type: Male, in U.S. National Museum, USNM 25551.

Type locality: Venadio, Sinaloa, Mexico.

Food plant: Unknown.

Distribution: Guadalajara, Jalisco, and Venadio, Sinaloa, Mexico.

Remarks: The rather broad and straight or nearly straight ochreous medial line distinguishes *gloriella* from all other species of *Haimbachia*. As noted under *discalis*, the male genitalia of it and *gloriella* are very much alike, but the two are readily distinguished from each other by the character of the distal hook of the aedeagus; in *discalis* it is sharply

pointed and in *gloriella*, distinctly truncate. The female genitalia of *gloriella* resemble those of *floridalis* and *albescens*, but are distinguished from them by differences in the tonguelike projection; in both *floridalis* and *albescens* the median area of the bifurcation is rather deep and distinctly angulate; in *gloriella* it is shallow and broadly concave.

Haimbachia placidella (Haimbach)

Figures 1, 18

Crambus placidellus Haimbach, 1907, Ent. News, vol. 18, p. 44.
Chilo placidellus (Haimbach).—Keafortt, 1908, Proc. U.S. Nat. Mus., vol. 35, p. 392.
Haimbachia placidella (Haimbach).—Dyar, 1908, Proc. Ent. Soc. Washington, vol. 11, pp. 28–29.—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 140, no. 5401.—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 35.—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 25, no. 5966.

Alar expanse: Male 15–18 mm.; female 17–19 mm.

Frons round. Head and thorax whitish; palpi ochreous white, mixed with pale fuscous laterally and distally. Forewing: Upper surface white, with an ochreous tinge, moderately irrorated with brownish fuscous. Medial line pale buff, origin from near middle of costa, broadly concave outward, loop enclosing the cell extending but slightly beyond end of the cell; thence straight or but slightly sinuate and oblique inward, terminating on inner margin before middle. Inner and outer margins of subterminal band pale buff, straight or but slightly incurved between veins 1b and 3. Interspace of veins ochreous from termen to subterminal band. Terminal line discontinuous, as blackish patches. Fringe metallic. Hindwing: Upper surface whitish, with a slight ochreous tinge. Fringe white.

Male genitalia (figs. 1–1b): Symmetrical. Costa of dorsal basal lobe of harpe broadly triangulate in shape; the toothlike projection slender, concave, bluntly pointed distally. Aedeagus slender, with numerous small spinules and a toothlike projection near middle of a long, narrow, straplike sclerotization.

Female genitalia (fig. 18): The tonguelike projection bifurcate, apices bluntly pointed; median area of bifurcation acutely angulate, rather deep. Ventral margin of ostium weakly sclerotized, convex. Ductus bursae longitudinally rugose for almost its entire length. Ductus seminalis with origin about midway between ostium and junction of ductus bursae and bursa copulatrix. Signa two small, round, weakly scobinate, sclerotized patches.

Type: Male, in U.S. National Museum, USNM 11956.

Type locality: Wenonah, New Jersey.

Food plant: Unknown.

Distribution: Connecticut, New Jersey, Pennsylvania, and Tennessee.

Remarks: The ochreous facies, broader, diffuse definition of the medial line and margins of the subterminal band, with termination of the former anterior to middle of the inner margin of the wing, distinguish *placidella* from other species of the genus. The male genitalia of *placidella* are somewhat similar to those of *dumptalis* and *quiriguella*, but in *dumptalis*, costa of the dorsal basal lobe of the harpe is broadly rounded, curvature of the distal hook undulate and the aedeagus without a conspicuous toothlike projection; in *quiriguella*, the triangular costal production of the dorsal basal lobe is narrower than in *placidella*, the hook knoblike distally and the aedeagus serrate distally. The female genitalia of *placidella* resemble those of *dumptalis*, but in *placidella* there is no distinct constriction of the ductus bursae between ostium and origin of the ductus seminalis; the rugosity of the ductus bursae is more extensive and the angulation of the median area of the bifurcation of the tonguelike projection is more acute and deeper than in *dumptalis*.

Haimbachia cochisensis, new species

FIGURE 19

Alar expanse: Female 20 mm.

Frons round. Head, thorax, and palpi white, with some mixture of pale buff. Facies whitish. Forewing: Upper surface white, irrorated with ochreous brown. Medial line narrow, pale buff; origin from costa slightly before middle, oblique outward to upper angle of cell, loop enclosing cell narrow and extending well beyond end of cell, oblique inward from lower angle of cell to vein 2, thence zigzag to inner margin of the wing, terminating before middle. Subterminal band with central area white; inner and outer margins pale buff; indentation of inner margin at vein 2 deep and acute; that of outer margin much weaker. Terminal line discontinuous, as narrow, dark fuscous patches. Fringe with metallic cilia. Hindwing: Upper surface sordid white; subterminal line weakly defined, rather diffuse. Fringe white, tipped with pale brown.

Female genitalia (fig. 19): The tonguelike projection weakly bifurcate, median area of bifurcation angulate, broadly obtuse. Ventral margin of ostium weakly sclerotized, with a short, stout, median projection. Two signa, each a small, round, sclerotized patch with a short, blunt, conical production.

Type: Female, in U.S. National Museum, USNM 65007.

Type locality: Douglas, Arizona.

Food plant: Unknown.

Remarks: The deep, acute indentation of the inner margin of the subterminal band at vein 2 and lack of a conspicuous discocellular patch on the forewing will distinguish *cochisensis* from the other species of the genus with a round frons; the rather short, conelike median projection of the ventral margin of the ostium is diagnostic for the female genitalia of *cochisensis*.

Males unknown but when available, there should be no difficulty in association of the sexes.

Haimbachia diminutalis, new species

Figures 16, 20

Alar expanse: Male 10–12 mm.; female, 15–16 mm.

Frons round. Head and thorax white; palpi whitish, with some intermixture of pale brownish fuscous. Forewing: Upper surface white with a slight ochreous tinge, irrorated with buff. Medial line buff, weakly defined, with origin from middle of costa, oblique outward to stalk of veins 8 and 9, loop enclosing cell broadly concave, extending well beyond end of the cell, thence strongly oblique and slightly sinuate to inner margin of the wing, terminating near middle. Subterminal band with central area whitish, origin from costa about one-fourth length of costa before apex; inner margin of band oblique outward to vein 6, broadly curved to vein 2, thence zigzag to inner margin of the wing; outer margin of band parallel to inner margin or nearly so. Terminal line blackish, continuous or weakly interrupted. Fringe nonmetallic; cilia grayish with pale brownish fuscous tips. Hindwing: Upper surface white, terminal line narrow, pale buff. Fringe white.

Male genitalia (figs. 16–16b): Asymmetrical. The hooklike production from dorsal basal lobe of harpe greatly expanded about midway between base and distal end. Uncus normal. Aedeagus long, slender; cornuti consisting of numerous short spinules in a linear arrangement.

Female genitalia (fig. 20): The tonguelike projection strongly bifurcate, apices sharply pointed, median area of bifurcation angulate and rather deep; the projection divided into two elements from base of bifurcation to near loop of the projection, the ventral element narrow, straplike. Ventral margin of ostium moderately sclerotized, with a short, stout, sharp, angulate medial production. Signum obsolescent; one or none; if discernible, a very small, round, weakly sclerotized patch.

Type: Male, in U.S. National Museum, USNM 65008.

Type locality: Brownsville, Texas.

Paratypes: Texas: Brownsville, 2 males; San Benito, 3 males, 1 female; Brewster Co., 1 female. Arizona: Baboquivari Mountains, Pima Co., 1 male and 1 female; Redington, 1 female.

Food plant: Unknown.

Remarks: The character of the hooklike projections from the dorsal basal lobes of the harpes and slender aedeagus with linear arrangement of the cornuti are diagnostic for the male genitalia of *diminutalis;* the division of the tonguelike projection into two elements from base of the bifurcation to near the loop distinguishes the female genitalia of it from all others of the group.

Alamogordia prosenes (Dyar), new combination

FIGURE 5

Diatraea prosenes Dyar, 1912, First Ann. Report, Laguna Mar. Lab., p. 165.

Chilo prosenes (Dyar).—Barnes and McDunnough, 1917, Check list of the Lepidoptera of Boreal America, p. 141, no. 5433.

Haimbachia(?) *prosenes* (Dyar).—Dyar and Heinrich, 1927, Proc. U.S. Nat. Mus., vol. 71, p. 37.

Haimbachia prosenes (Dyar).—McDunnough, 1939, Mem. Southern California Acad. Sci., vol. 2, p. 25, no. 5698.

Alar expanse: Male 23 mm.; female 20–31 mm.

Larger than most *Haimbachia* species. Frons round. Head, thorax, and abdomen sordid white. Palpi sordid white with intermixture of smoky fuscous. Forewing: Ground color whitish, interspace of veins heavily sprinkled with brown or fuscous, the wing appearing lined. Medial transverse line absent. Postmedial transverse line brownish; origin from costa about one-fourth length of the wing before apex, strongly oblique outward to near apex, thence bent and continuing subparallel to the termen, terminating near middle of inner margin of the wing. Terminal line brownish or fuscous, narrow, continuous. Fringe nonmetallic; whitish. Hindwing: White, with slight buff suffusion. Fringe white.

Definition of the postmedial transverse line and lined appearance of the forewing is weaker in the females than in the males.

Male genitalia as figured (figs. 5, 5a).

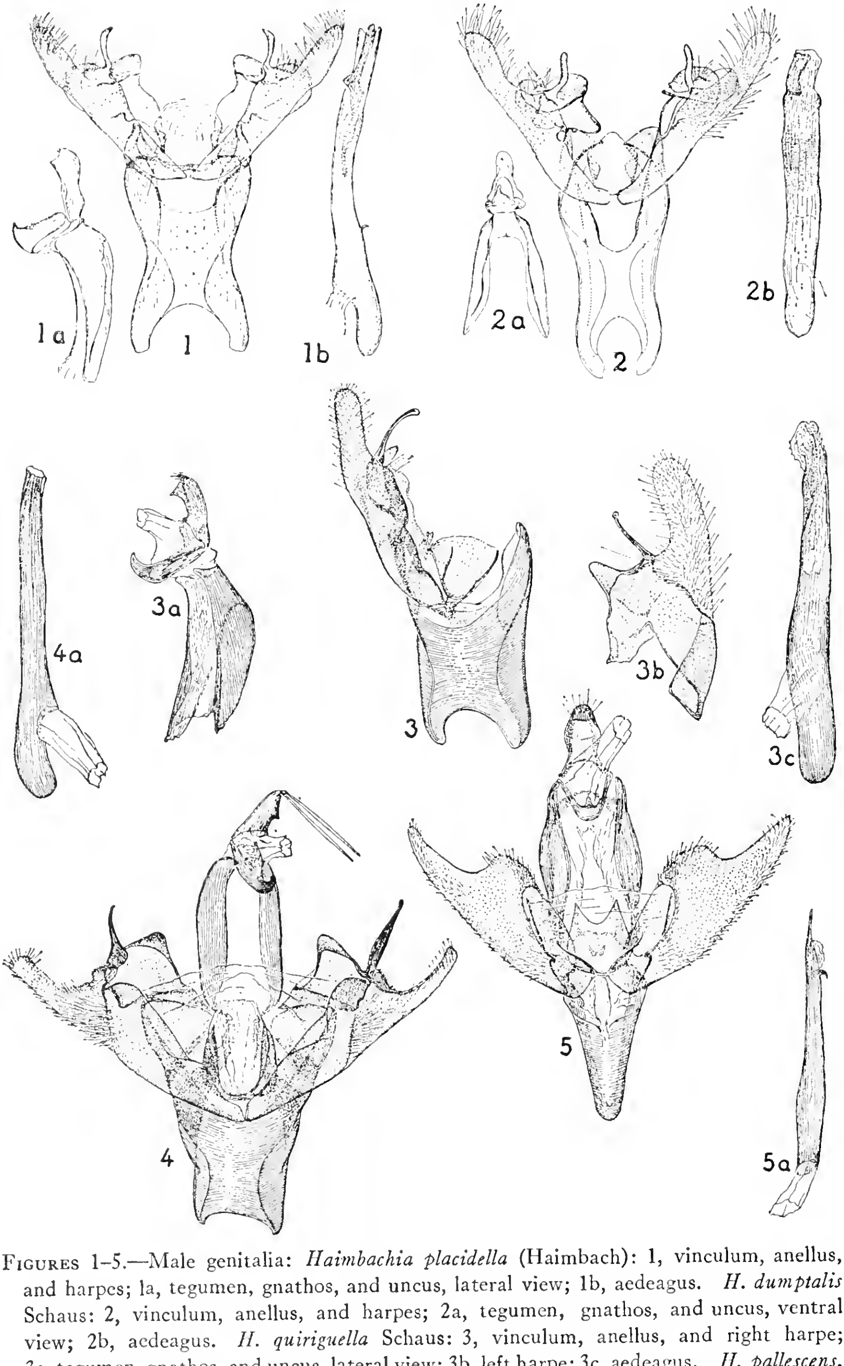
Type: Female, in U.S. National Museum, USNM 14352.

Type locality: Laguna Beach, California.

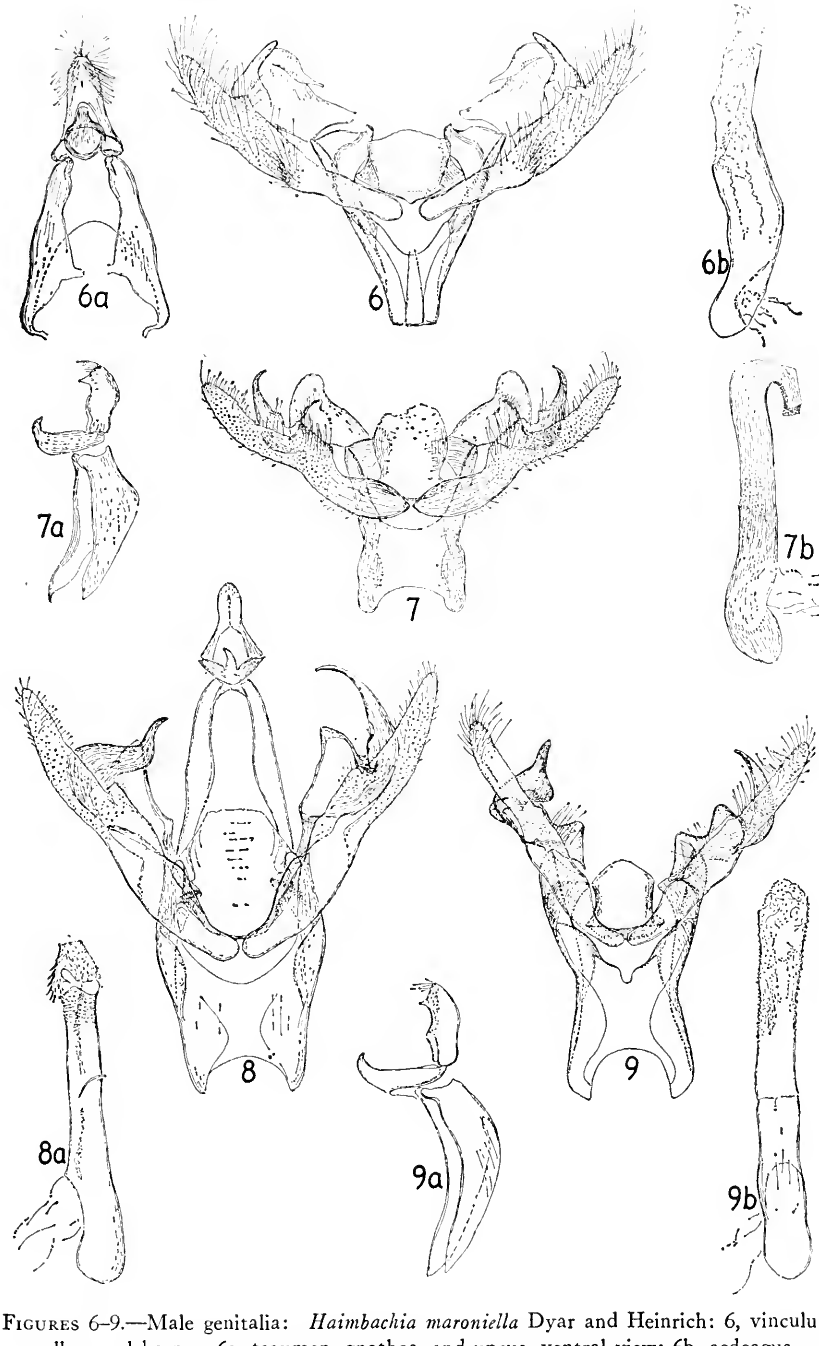
Food plant: Unknown.

Distribution: Glendale, Los Angeles, San Bernardino, and La Puerta Valley, California.

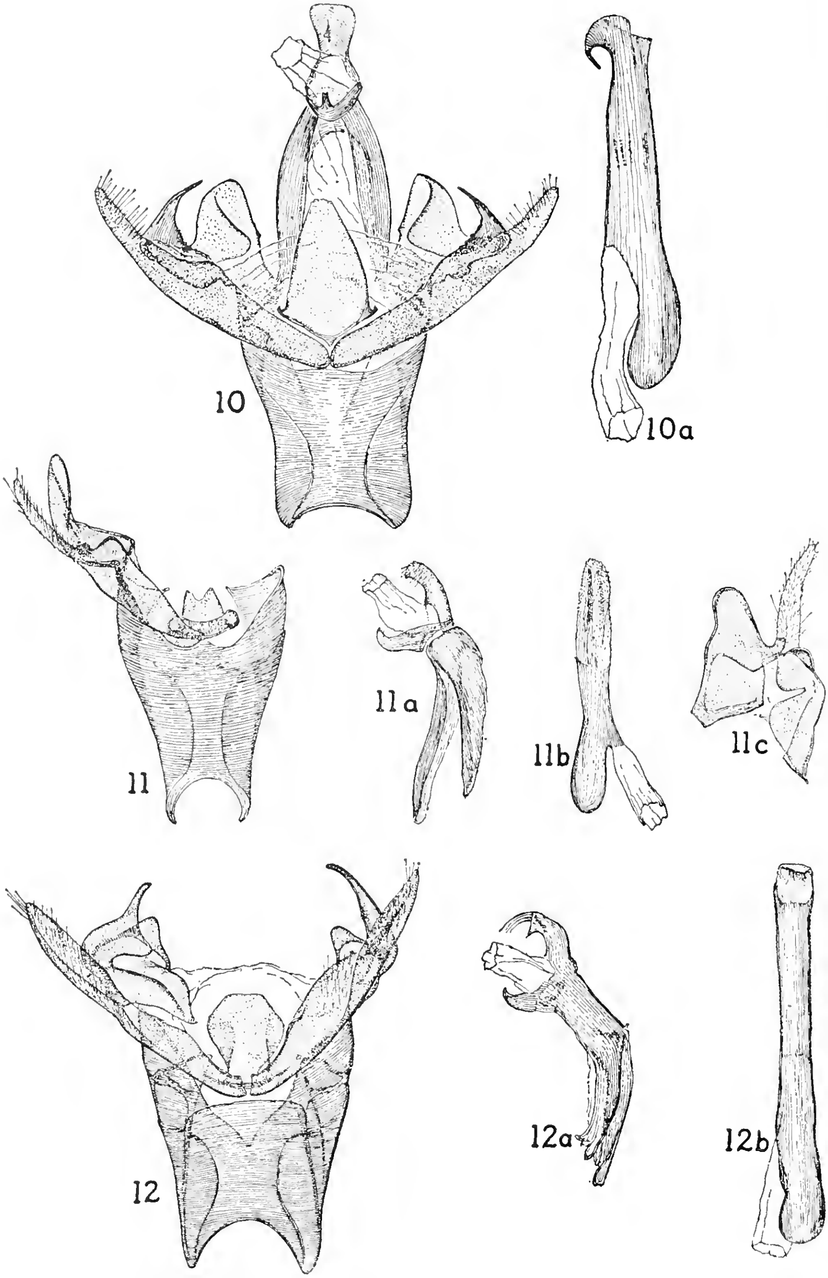
Remarks: Dyar and Heinrich transferred *prosenes* from *Chilo* to *Haimbachia* with considerable reservation, due to the lack of males for study. Since then, with the acquisition of the Barnes collection by the U.S. Department of Agriculture, males became available and dissection of their genitalia revealed that the species is definitely not a *Haimbachia* and properly belongs in *Alamogordia*, to which it is hereby transferred.



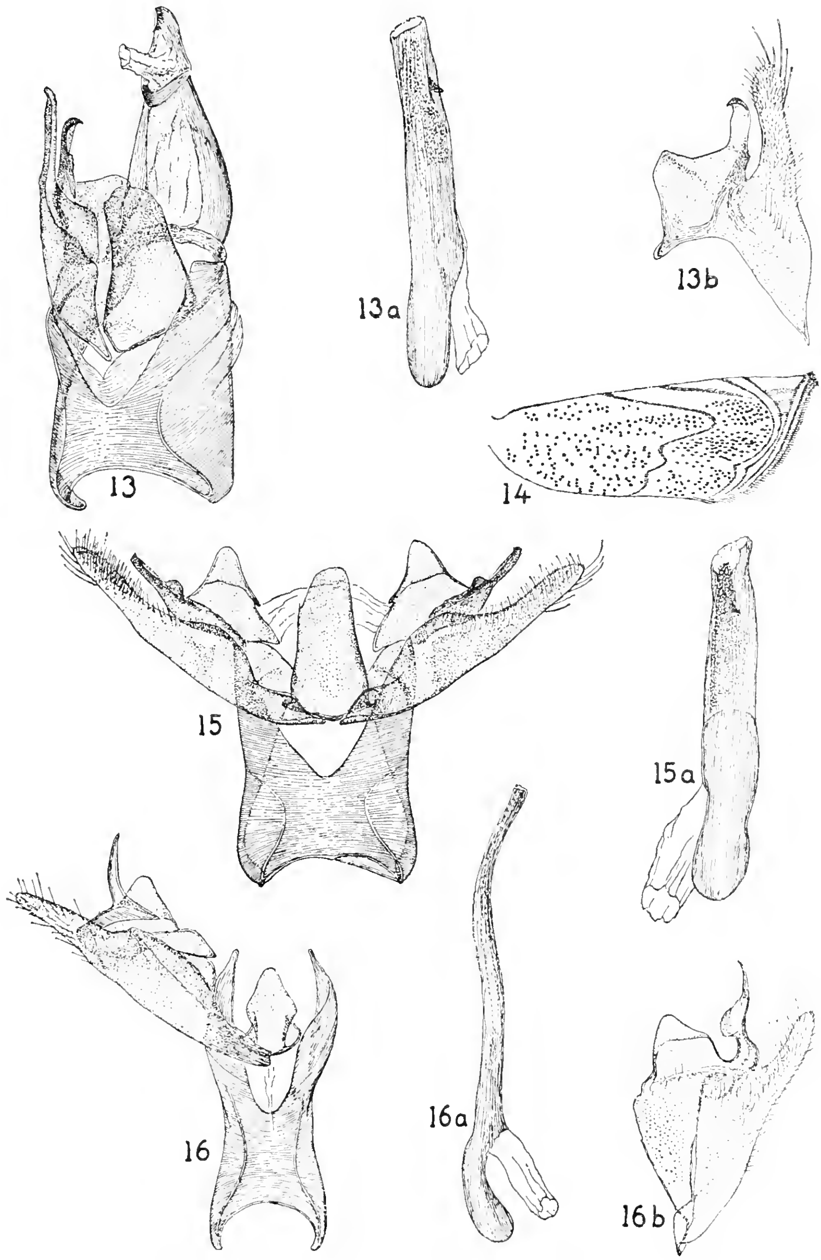
FIGURES 1–5.—Male genitalia: *Haimbachia placidella* (Haimbach): 1, vinculum, anellus, and harpes; 1a, tegumen, gnathos, and uncus, lateral view; 1b, aedeagus. *H. dumptalis* Schaus: 2, vinculum, anellus, and harpes; 2a, tegumen, gnathos, and uncus, ventral view; 2b, aedeagus. *H. quiriguella* Schaus: 3, vinculum, anellus, and right harpe; 3a, tegumen, gnathos, and uncus, lateral view; 3b, left harpe; 3c, aedeagus. *H. pallescens*, new species: 4, genitalia with only the aedeagus removed: 4a, aedeagus. *Alamogordia prosenes* (Dyar): 5, genitalia with only the aedeagus removed; 5a, aedeagus.



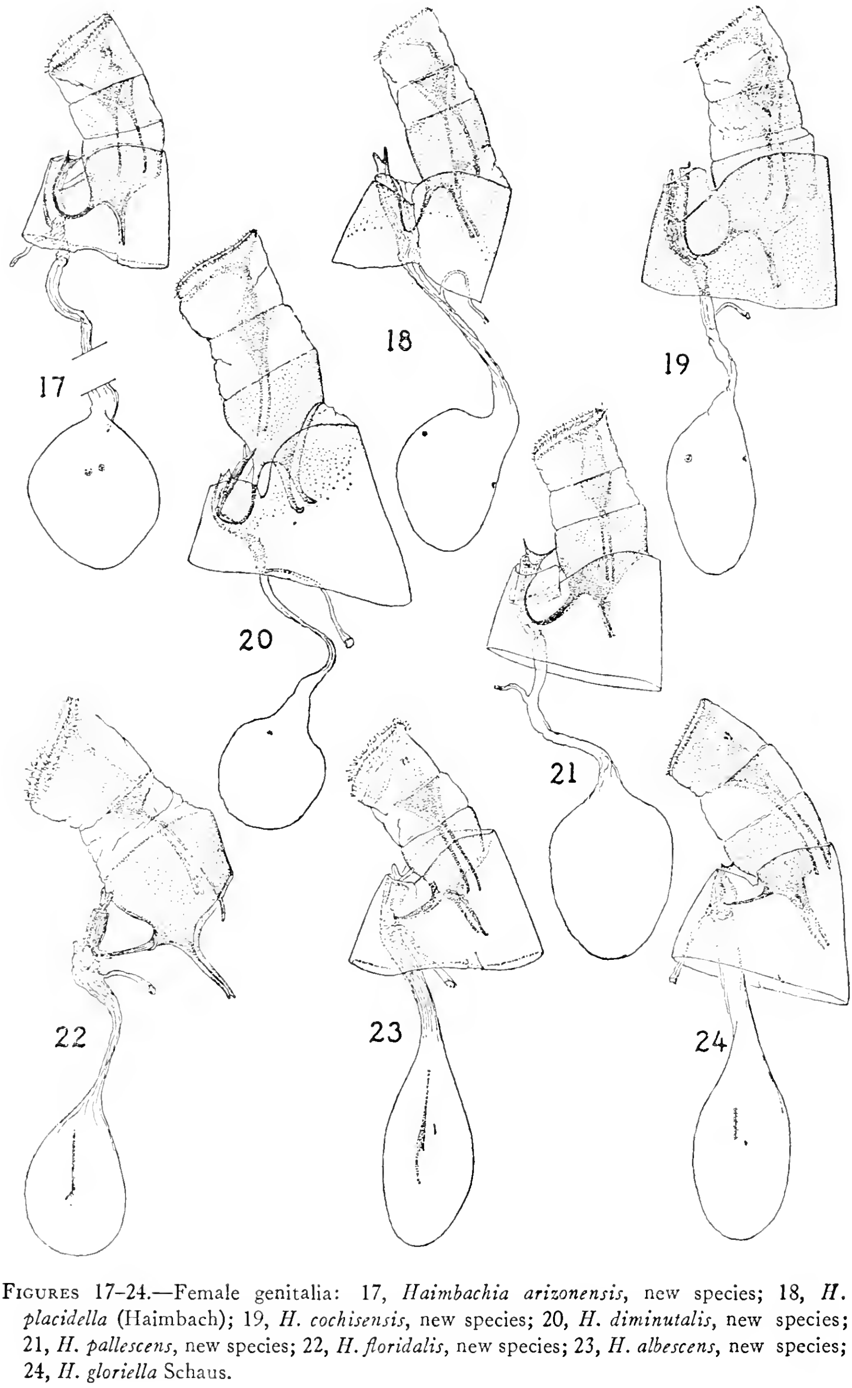
Figures 6–9.—Male genitalia: *Haimbachia maroniella* Dyar and Heinrich: 6, vinculum, anellus, and harpes; 6a, tegumen, gnathos, and uncus, ventral view; 6b, aedeagus. *H. gloriella* Schaus: 7, vinculum, anellus, and harpes; 7a, tegumen, gnathos, and uncus, lateral view; 7b, aedeagus. *H. squamulella* (Zeller): 8, genitalia with only the aedeagus removed; 8a, aedeagus. *H. prestonella* Schaus: 9, vinculum, anellus, and right harpe; 9a, tegumen gnathos, and uncus, lateral view; 9b, aedeagus.



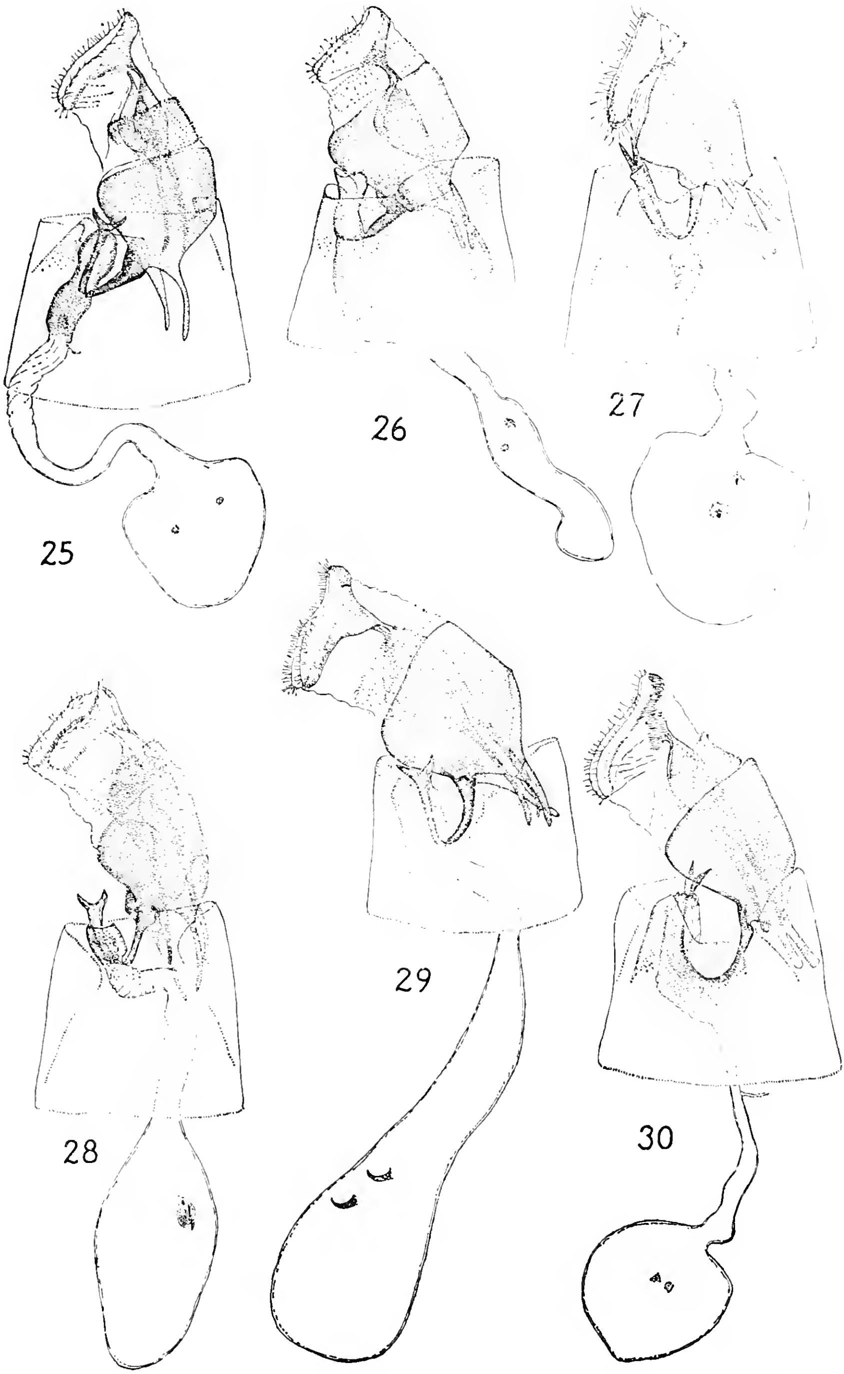
FIGURES 10–12.—Male genitalia: *Haimbachia discalis* Dyar and Heinrich; 10, genitalia with only the aedeagus removed; 10a, aedeagus. *H. indistinctalis*, new species: 11, vinculum, anellus, and right harpe; 11a, tegumen, gnathos, and uncus, lateral view; 11b, aedeagus; 11c, left harpe. *H. arizonensis*, new species: 12, vinculum, anellus, and harpes; 12a, tegumen, gnathos, and uncus, lateral view; 12b, aedeagus.



Figures 13–16.—Male genitalia and wing: *Haimbachia floridalis*, new species: 13, genitalia with left harpe and aedeagus removed; 13a, aedeagus; 13b, left harpe. *H. squamulella* (Zeller): 14, upper surface of forewing depicting essential elements of maculation. *H. albescens*, new species: 15, vinculum, anellus, and harpes; 15a, aedeagus. *H. diminutalis*, new species: 16, vinculum, anellus, and right harpe; 16a, aedeagus; 16b, left harpe.



FIGURES 17–24.—Female genitalia: 17, *Haimbachia arizonensis*, new species; 18, *H. placidella* (Haimbach); 19, *H. cochisensis*, new species; 20, *H. diminutalis*, new species; 21, *H. pallescens*, new species; 22, *H. floridalis*, new species; 23, *H. albescens*, new species; 24, *H. gloriella* Schaus.



FIGURES 25–30.—Female genitalia: 25, *Haimbachia dumptalis* Schaus; 26, *H. maroniella* Dyar and Heinrich; 27, *H. prestonella* Schaus; 28, *H. discalis* Dyar and Heinrich; 29, *H. quiriguella* Schaus; 30, *H. squamulella* (Zeller).

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GENUS LEXIPHANES OF AMERICA NORTH OF MEXICO (COLEOPTERA: CHRYSOMELIDAE)[1]

By Edward U. Balsbaugh, Jr.[2]

Introduction

The taxonomic history of this group began with the generic establishment of *Monachus* Chevrolat (1837) in Dejean's "Catalogue." Chevrolat created the genus by separating species from large genera such as *Clytra* Laicharting and *Cryptocephalus* Geoffroy. He did not describe the genus, but it did possess nomenclatorial validity because of the inclusion of valid specific names. Although Suffrian (1852) published the first generic description, he was erroneously cited as generic author by Gemminger and von Harold (1874), Clavareau (1913), and Leng (1920).

Gistel (1848) proposed the current valid name *Lexiphanes* after he saw that *Monachus* Chevrolat was preoccupied: *Monachus* Fleming, 1822 and *Monachus* Kaup, 1829. *Lexiphanes* did not obtain recognition until Blackwelder (1946) published his neotropical catalog.

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[1] Modified from a master's thesis submitted to Pennsylvania State University and completed in the employ of the Pennsylvania Department of Agriculture.

[2] Department of Zoology-Entomology, Auburn University, Auburn, Ala.

Leng (1918) further introduced *Monachulus* (now in synonymy) also to replace preoccupied *Monachus* Chevrolat.

The first known North American species, *Cryptocephalus saponatus*, was described by Fabricius in 1801. Nearly forty years later Perbosc (1839) described *Cryptocephalus guerini*. *Monachus ater*, *M. affinis*, and *M. auritus* were described by Haldeman (1849). *Monachus seminulum* was described by Suffrian (1858) and *Monachus thoracica* by Crotch (1873). The remaining species, described in the twentieth century, are: *Monachus mexicanus* Jacoby (1908); *Monachulus viridanus* Fall (1927); and *Monachulus opacicollis* Schaeffer (1933). A key to the species then known for the genus in America north of Mexico was published in 1880 by LeConte. Wickham (1895) used part of this key in his paper on the tribe Cryptocephalini in his series on Canadian Coleoptera. Blatchley (1910) also presented a key, but only to the species occurring in Indiana. In the present study, five distinct species are recognized in Nearctic America north of Mexico. Four of the above specific names are here synonymized and two junior synonyms re-established as senior.

Origin and distribution: The genus *Lexiphanes* occurs only in the Western Hemisphere. Comparatively speaking, North America is poorly represented in the genus. Blackwelder (1946) lists twenty-three species from Central America, whereas ninety-three were recorded for South America. Assuming no reduction of range, northern South America appears to be the center of distribution and the probable center of generic origin. Two faunal regions include the five North American species: the eastern United States as far west as the plains, and the southwestern United States, including parts of Texas, Colorado, New Mexico, and Arizona. The western species represent the northernmost distributions of a Central American group. The three eastern species are possibly completely disjunct from their Central American relatives.

Methods and terminology: The abdomen was removed and cleared overnight in 10 percent solution of sodium hydroxide. The genitalia were removed from the abdomen, washed in distilled water, examined, and stored in glycerine in micro-vials attached to the insect pin. The empty abdomen was washed and mounted on a paper point beneath the insect. The aedeagi were measured from the apical tip to the anterior end of the internal sac. The total length of the beetle was taken from the front of the pronotum to the apex of the elytra, while the width was measured at the widest part (slightly behind the humeral calli).

A study of this kind requires assemblage of a large amount of material. The author has been fortunate enough to examine large series of specimens through loans from various institutions. For the

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Systematic Treatment

North American *Lexiphanes* display several colors and considerable variability: piceous, brownish black, blue green, dark bronzed green, and yellowish red. Their general shape can best be described as being keglike; the body length averaged 1.4 times the width. The compact form, along with its colors and patterns, usually permits easy recognition of these beetles without close scrutiny of diagnostic characters.

The head is hypognathous, nearly circular, and fits tightly in the prothorax. From directly above, the head is most often invisible. The eyes are strongly emarginate and those of the male more closely contiguous than those of the female. The subserrate, 11-segmented antennae arise in the emargination of the eyes and extend the length

of the pronotum. The first five segments are narrow while the apical six become wider, more triangular in shape. Antennal segmental coloration varies within species by the number of basal segments, which are of lighter hues. The mouth parts are difficult to observe due to the hypognathous head. The rounded labrum often is lighter, as are the basal antennal segments. The terminal segments of the labial and maxillary palpi are gradually accuminated. The mentum is not visible.

Pronotal convexity greatly contributes to a compact shape. The rapidity of taper of the pronotum as it narrows anteriorly yields varying degrees of robustness. (Some species have the lateral edges of the pronotum more nearly parallel than others.) Since the pronotal lateral margins lie beneath the curvature of the body, they are invisible from above. Slightly below the middle these form right angles where they meet the anterior pronotal margin. Pronotal markings are of some specific distinctive value, but punctation and sculpture are also quite variable. Setae can be seen at the four pronotal angles on clean specimens. No diagnostic value was placed on the long and narrowly triangular scutellum.

Elytral striae become obscure near the posterior end. Interstrial punctures are much finer than the strial. In some species the submarginal striae are more deeply impressed than the remainder, and the epipleura are well developed along the thorax but narrow quickly along the abdomen.

The transversely subrectangular prosternum extends between the two anterior coxal cavities, which are closed behind. The middle coxal cavities are open behind. Mesopleural and metapleural sclerites are distinct. The mesosternum is subrectangular, approximately twice as broad as long, and the metasternum is likewise wider than long. Median sutures and sternal coxal lines can also be seen on some species, and various degrees of punctation are noticeable on the thoracic sternites and pleurites.

The abdomen is composed of five sternites, the first being the widest. This basal sternite has a broad (often ⅕ the width), truncate intercoxal process. The length of all five abdominal sternites together does not equal the width of the abdomen. Punctation and rugosities on the abdominal sternites sometimes allow specific distinctions. Sexual differences are visible on the fifth abdominal sternite.

The legs are always widely separated. The anterior and middle coxae are globular; those of the hindlegs are transverse. The trochanters are shaped like right triangles with their "hypotenuses" bounding the femoral base. The femora are slightly swollen—the anterior the most and the hind the least. A shallow groove is notice-

able along the distal ventral edge for reception of the tibia. The lateral and dorsal surfaces are evenly rounded. The tibiae have the dorsal side subcarinate, especially the hindtibiae, while the corbels of all legs are setose in a single, lateral row. The tarsi are cryptopentamerous with the fourth segment strongly reduced. The strongly biramous third segment is padded beneath, along with the first and second segments. The ungues are appendiculate; however, the claws of some *L. saponatus*, collected in the vicinity of Lake Marion, Florida, were less appendiculate and more slender (figs. 7, 8).

The wings are fully formed (fig. 9), but no diagnostic use is here made of these structures. Since the wings of *Lexiphanes* show no closed cells, the beetles are a primitive chrysomelid type (Crowson, 1960).

Beetles of this genus show little pubescence. Setae are generally absent dorsally. Ventrally they are short and sparse. Sometimes the first and fifth abdominal segments are hirsute. Some species have the terminal antennal segments more heavily pubescent than the basal ones. Sparse setae occur on the tibiae of some species. Pronotal setae and tarsal pads have been noted previously.

The sexes can be distinguished by the presence of a fovea on the fifth abdominal sternite (present in the female, absent in the male), the degree of approximation of the eyes (the males' being closer together), and the usually smaller size of the male; however, the relativity of these latter two criteria makes them less valuable. When the pygidium is raised, paired sclerites in the genital opening indicate a female, and the apical tip of the aedeagus, the male.

Male genitalia of *Lexiphanes* were investigated by Powell (1941), primarily to show generic and interfamily relationships; however, the present study found them to also have specific diagnostic value (fig. 6 shows a fully labeled aedeagus). One part of the female reproductive structure, the spermatheca, was also found to be useful taxonomically.

Little is known concerning life habits of this genus. The earliest and latest dates of collection for each species are shown by state or province. Plants upon which beetles have been collected are listed under biology for each species. Only one specimen of the material examined was indicated as having been collected at light.

Beetles of this genus have not been reported to be of economic importance. One report showed *Lexiphanes saponatus* (Fabricius) to have been feeding on cotton on the upper epidermis and parenchyma, occasionally making holes through the leaves (Folsom, 1936).

As I have been unable to find that a type species had ever been designated for this genus, I subsequently designate *Lexiphanes saponatus* (Fabricius). Preference is given this species because it is

the best known. (It probably was also well known to Chevrolat prior to his publishing the generic name.) This species has a wide distribution, and is typical by size and form of the genus, both Nearctic and Neotropical.

Genus *Lexiphanes* Gistel

Monachus Chevrolat, 1837, p. 425. [Preoccupied by *Monachus* Fleming, 1822, and *Monachus* Kaup, 1829.]

Lexiphanes Gistel, 1848, p. 123. [Type species, by present designation: *Cryptocephalus saponatus* Fabricius, *Lexiphanes saponatus* (Fabricius), 1801, vol. 2, p. 55.]

Monachulus Leng, 1918, p. 208.

Key to the Nearctic Species of *Lexiphanes*

1. Elytra black on bluish black with pale median spot or transverse fascia (except some forms of *mexicanus* found only in Mexico); southwestern species 2
   Elytra entirely black or bluish black without pale median spot or transverse fascia; eastern species 3
2. Pronotum shining, distinctly punctate, the punctures fine and generally evenly distributed over entire surface; 2.08–3.00 mm. long. **guerini** (Perbosc)
   Pronotum dull, not distinctly punctate; some medial basal punctures occasionally present; 2.16–2.60 mm. long . . . . . . **mexicanus** (Jacoby)
3. Interstrial space between marginal and submarginal striae convex along entire length of elytra; small species; 1.58–2.25 mm. long 4
   Interstrial space between marginal and submarginal striae not convex for entire length of elytra; large species; 2.16–3.08 mm. long. **saponatus** (Fabricius)
4. Last ventral abdominal segment uniformly convex with a fovea 5
   Last ventral abdominal segment uniformly convex without a fovea 6
5. Last ventral abdominal segment with a callus on either side of the fovea; pronotum with no or very obscure punctures along basal line; 2.08–2.23 mm. long . . . . female **affinis** (Haldeman)
   Last ventral abdominal segment without a callus on either side of the fovea; protonum with a basal line of punctures; 1.91–2.25 mm. long. female **seminulum** (Suffrian)
6. Last ventral abdominal segment and abdominal intercoxal process with punctures; pronotum with no, or very obscure punctures along basal line; 1.75–2.08 mm. long . . . . male **affinis** (Haldeman)
   Last ventral abdominal segment without punctures; abdominal intercoxal process rugose; pronotum with a basal line of punctures; 1.58–2.00 mm. long . . . . male **seminulum** (Suffrian)

Lexiphanes guerini (Perbosc, 1839)

FIGURES 1, 10, 15

Cryptocephalus guerini Perbosc, 1839, p. 264.
Monachus guerini (Perbosc).—Suffrian, 1852, p. 216.
Monachulus guerini (Perbosc).—Leng, 1920, p. 290 (checklist).
Lexiphanes guerini (Perbosc).—Blackwelder, 1946, p. 643 (checklist).

Diagnostic description: Frons red, dorsum when visible usually black, with punctules; several distinct setae on clypeus; antennae subequal to length of head and pronotum combined, basal segments tawny becoming darker distally, segments six through eleven broader, flattened, and more setose. Pronotum yellowish red with black discal spots; punctation fine and generally scattered over entire pronotum, the punctures not as broad as elytral punctures. Prosternum yellowish red, rugulose; pronotal epipleura smooth. Elytra black with transverse yellowish-red fascia; deeply impressed marginal and submarginal

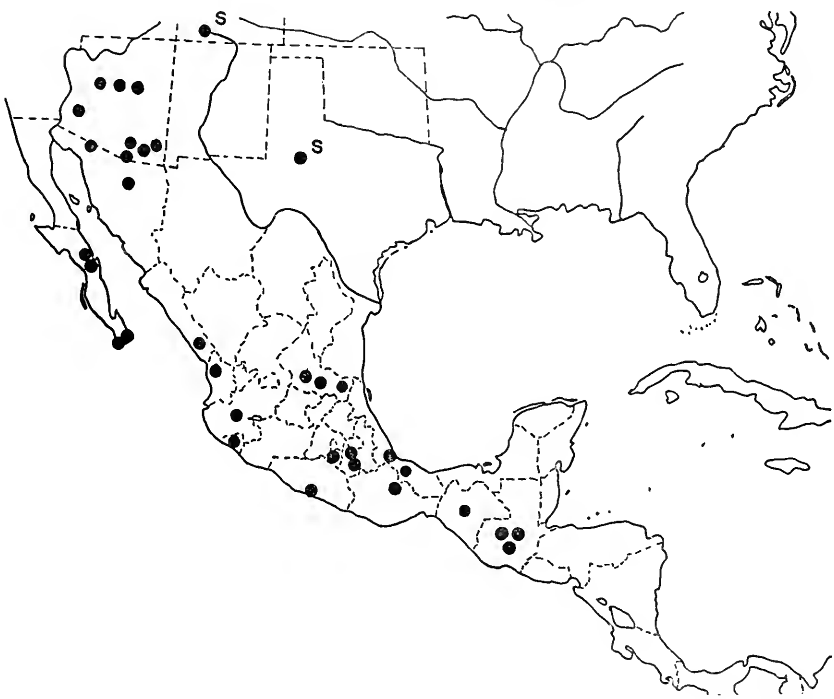


FIGURE 1.—Geographic distribution of *Lexiphanes guerini* (Perbosc). S=state locality.

striae, other striae becoming effaced medially and posteriorly, their punctation on the fascia showing small, dark, "water soaked" spots. Venter black, at times iridescent green or deep purple, with distinct punctures. Legs dark with lighter variations in the forelegs.

Variation: The observed size range in millimeters is 2.08 long by 1.50 wide to 3.00 long by 2.08 wide. The average size is 2.48 long by 1.75 wide. A variational effect, which appears to be clinal in nature, runs in a general north-south direction. Those specimens collected in the northernmost range of the species have the two pronotal discoidal spots smaller or absent, while collections farther south show these spots progressively enlarging, finally meeting or completely fusing into

one spot. The coloration of the dark areas of the more northern specimens tends to be black (ventrally showing more brownish) with less or little of the bluish purple or greenish iridescence shown by specimens from Mexico. The population from the area of Bill Williams Fork, Ariz., which show no pronotal discal spots were not named as a subspecies because of the paucity of specimens. Future collections from the northern areas of Mexico and into Arizona may show that subspecies do exist.

Male genitalia: The average length of the aedeagus is 1.12 mm. The ventral apical lobe is short, not extending far beyond the dorsal plate. The outline of the ventral apical lobe is straight when viewed laterally and not convex as is *L. saponatus* (fig. 17). The length of the aedeagi showed no overlap in size with those of *L. mexicanus* (fig. 16), which are of a similar appearance but smaller. Five specimens were dissected.

Female genitalia: The spermatheca is similar in appearance to that of *L. mexicanus* (fig. 11). Specimens of *L. guerini* have the bulbous basal portion less globular, showing a bulge only on the proximal side. The distal section has a slight bend and lacks the apical hook of *L. mexicanus*. Two specimens were dissected.

Biology: The following information was observed on specimen pins: "Maiz, Alamos, Sonora, Dec. 6;" "Hosp. Anis, Cotaxtla, Veracruz, Feb. 10."

Type: This specimen could not be located by this author and if it still exists is probably in some European museum. Perbosc (1839) gave its measurements as 3 mm. long and 2 mm. wide.

Type locality: "Environs de la Vera-Cruz. (Mexico)" (Perbosc, 1839).

Paratype: A female, 3.00 mm. long and 2.00 mm. wide, in the British Museum (Natural History) was examined. "Baly Coll." "*Monachus guerini* Perbosc rev. zool. Mexico 1839 sp. 5."

Distribution: In the United States this primarily Mexican species is found in Colorado, Arizona, and Texas; populations in the United States are pioneers invading through the "Sonoran tension zone." Further collections may show that the species occurs in southern California, New Mexico, and possibly Nevada, and Utah.

The material examined included 208 specimens from the following localities:

GUATEMALA: El Rancho, Guatemala City, Los Ametes.

MEXICO: Baja California: Cape San Lucas; Comondú, July 2; Purissima, October; San José del Cabo. Chiapas: Tuxtla Gutiérrez, Sept. 25. Colima: Colima, July 21. Guerrero: Acapulco, Aug. 18. Jalisco: La Resolana, Nov. 20. Morélos: Cuautla, May 28, Aug. 21; Cuernavaca, 2600 ft. Nayarit: 994.5 km., May 24; Río de las Canyas, Matamoros, May. San Luis Potosí: El Salto, 1700 ft.; Llera, May 21; Tamezunchale; Valles, Jan. 28. Sinaloa: Rosario, Mar. 17. Sonora: Alamos, Dec. 6; Sonoyta,

1500 ft., Apr. 4. Veracruz: Cosamaloapán, July 20; Cotaxtla, Feb. 10; Santa Lucrecia; "Tephambres"; Veracruz, July. Unknown localities: Real de Arriba, Temescaltepec, July 19.

UNITED STATES: Arizona: cochise co.: Palmerlee. gila co.: Globe; Phoenix; Salt River, Aug. 23; San Carlos, Mar. 10; Wheatfields (near Globe); Winkleman. pima co.: Tucson. santa cruz co.: Nogales. yuma co.: Bill Williams Fork.

Colorado: no further data.

"D.C.": locality questionable.

Texas: no further data.

Lexiphanes mexicanus (Jacoby, 1908)

Figures 2, 11, 16

Monachus mexicanus Jacoby, 1908, p. 830.
Monachulus opacicollis Schaeffer, 1933, p. 321. [New synonymy.]
Lexiphanes mexicanus (Jacoby).—Blackwelder, 1946, p. 643 (checklist).

Diagnostic description: Frons black, surface alutaceous; clypeus black and short; antennae a little longer than pronotum, basal segments narrow and fulvous, the apical six segments broader, flattened, darker, with setae more uniformly distributed and shorter than those of basal segments. Pronotum black, dull, alutaceous, with a few medial basal punctures, impunctate in some cases. Prosternum black, broader than long, finely alutaceous. Pronotal eipleura, black, alutaceous. Mesosternum black, finely alutaceous, with posterior marginal line. Elytra feebly shining, in some cases with faint metallic sheen; ground color black, in some cases with a hint of blue, with yellowish-red median fasciae which do not surround the humeri; striate-punctate, submarginal striae deeply impressed. Scutellum small and with straight edges. Venter black; fifth ventral abdominal segment of female with median fovea. Hindlegs black, middle and forelegs variable.

Variation: The observed size range, in millimeters, is 2.16 long by 1.50 wide to 2.60 long by 1.90 wide. The average size is 2.52 long by 1.75 wide. Some of the dark colors show a bit of blue or purple. The coloration of the prothorax was observed to vary from completely black to yellowish-red with black pronotal spots. The latter is the form of the here synonymized *L. opacicollis* Schaeffer. This form was found to predominate in the northern extremes of the species' range in much the same manner that specimens of *L. guerini* exhibited geographical variation. Size varied in the pronotal spots as well as in the width of elytral fasciae.

Discussion: The synonymization of *L. opacicollis* with *L. mexicanus* was made after genitalic comparisons proved the conspecificity of these two forms. In addition to having examined the holotype of *L. mexicanus* (British Museum, Natural History), Schaeffer's holo-

type of *L. opacicollis*, a male (USNM type 64989), was also seen. "S. Bernadino Rch. Cochise Co. VIII. Ariz."

Specimens from the Mexican states of Jalisco, México, and Colima were observed with much reduced or completely obliterated elytral fasciae. Beetles with this pattern may later be found to constitute a valid subspecies.

FIGURE 2.—Geographic distribution of *Lexiphanes mexicanus* (Jacoby).

Syntypes of *Lexiphanes sculptilis* (Jacoby, 1880) (British Museum, Natural History), were also seen. This species too may be a non-fasciate form of *L. mexicanus*. Genitalic comparisons of *L. mexicanus* and *L. sculptilis* indicated strong relationships between these two species, as no distinguishable difference was seen. Since no intergrade specimens between *L. mexicanus* and *L. sculptilis* were observed, these two names were not synonymized.

Male genitalia: The aedeagi of *L. mexicanus*, *L. opacicollis*, and *L. sculptilis* were found to be indistinguishable. Fourteen specimens were dissected.

Female genitalia: The spermatheca is similar in appearance to that of *L. guerini* (fig. 10). The basal portion of this structure in *L. mexicanus* is, however, more bulbous. Further, this structure in *L.*

sculptilis was found to be indistinguishable from that of *L. mexicanus*. Eight specimens were dissected, including two *L. sculptilis*.

Biology: One specimen was accompanied by associated plant data: "Mesquite-catcl., Juchitlan, Jalisco, Mexico. 4300 ft., July 25."

Type: Female, in British Museum (Natural History), "Yautepec, 15.175 Mexico, Jacoby Coll. 1909–28a."

Type locality: Yautepec (Morélos), Mexico.

Distribution: This species occurs from southern Arizona south through Mexico's Sierra Madre Occidental to about central Mexico, where its distribution extends eastward and southward through Mexico's southernmost state, Chiapas.

The material examined included 182 specimens from the following localities:

MEXICO: Chiapas: Carretera Panamericana, 970 km., Sept. 29; Chiapa de Corzo, Sept. 25; Tuxtla Gutiérrez. Colima: Colima City; Vulcano. Guerrero: Acapulco; Cañon del Zopilota, 28 km. N. Chilpancingo, July 30; Chilpancingo, 20 mi. S., 3700 ft.; Iguala, 20 mi. N.; Taxco, 4 mi. S., 4900 ft.; Taxco, 23 mi. N., 4700 ft.; Taxco, 8 mi. NE., 5450 ft.; Teloloapan; "Gurerrero" (no locality data), Sept. 13. Hildago: Ixmiquilpán, 19 mi. W., 1700 ft., July 29. Jalisco: Jalostotilán, 6 mi. NE., 6200 ft., Aug. 20; Juchitán, 4300 ft., July 25. México: Amecameca; Ixtapan, La Sal, 5500 ft.; 105 km. Carretera Toluca-Ixtapan de La Sal, Aug. 13; México; Tonatico; Valle de Bravo, July 1. Morelos: Campo Experimental Tepalcingo, Sept. 3; Cuernavaca; Cuernavaca-Acapulco Rd.; Cuernavaca, 12 mi. E., 4300 ft.; Cuernavaca, 16 mi. S.; Puenta de Ixtla, July 31; YMCA Camp, Tepoztlan. Oaxaca: El Camaron, 672 km., Sept. 29; Oaxaca, 5000 ft., July 8, Ruinas de Monte Alban. Sinaloa: La Concha, Aug. 13. Tamaulipas: Victoria, 6 mi. N., Nov. 17.

UNITED STATES: Arizona: cochise co.: Douglas, Aug. 9; Dragoon Mts., Sept. 10; San Bernardino Ranch, 3750 ft.; Tombstone.

Lexiphanes saponatus (Fabricius, 1801), new combination

Figures 3, 6–9, 12, 17

Cryptocephalus saponatus Fabricius, 1801, vol. 2., p. 55.
Monachus saponatus (Fabricius).—Chevrolat, 1837, p. 425.
Monachus ater Haldeman, 1849, p. 264. [New synonymy.]
Monachulus saponatus (Fabricius).—Leng, 1920, p. 290 (checklist).
Monachulus ater (Haldeman).—Leng, 1920, p. 290 (checklist).
Monachulus viridanus Fall, 1927, p. 139. [New synonymy.]

Diagnostic description: Piceous black, brownish black, blue, violet, bronzed green, and various other intergrade colors of these basic combinations. Head: Frons of same dark color as rest of body, generally flat, smooth, rugose, or rugulose and with punctures at times; the eyes deeply emarginate and not contiguous; the labrum tawny or also dark; antennae with basal segments more tawny than apical ones, anteroventral sides of basal antennal segments lighter at times. Segments one to five nearly uniformly round; segments six through

eleven, flatter and darker. Mouth parts tawny or dark. Pronotum dull or shiny, impunctate or punctate to varying degrees, the punctures and punctules originating medially and posteriorly. Posteromedial rugosities occasionally present. Prosternum broader than long; punctate or impunctate, the size of the punctures variable. Pronotal epipleura smooth, dull, with recessed areas for reception of forefemora. Elytra equal in gloss to, or more shiny than pronotum; with ten rows of strial punctures (excluding marginal striae); first striae terminating along suture; seventh, eighth, and ninth striae beginning from humeral calli; striae becoming effaced medially and posteriorly. Intervals occasionally rugulose and with punctules. Strial punctures of variable size and impression. Venter also of dark colors; varying degrees of punctation. Metepisterna with the most distinct punctures of undersides. Legs dark as rest of body. Tarsal claws generally stout and appendiculate, or more slender and less noticeably appendiculate.

Variation: The observed size range, in milimeters, is 2.16 long by 1.50 wide to 3.08 long by 2.00 wide. The average size of males (based on 89 specimens) was 2.40 long by 1.67 wide; for females, (based on 87 specimens) 2.83 long by 1.83 wide. Specimens of this species are quite variable and indicate that a cline exists. Color gradations are among its features. The northern members are more piceous while southern material more blue. The synonym, *L. ater*, was applied to a northern member. Distinctness of impression and size of punctures also appeared to become more prominent in the southern specimens. A clinal effect was further noticed in the increasing incidence of a smoother, more shining surface and distinct, but not large, punctures among specimens collected in northern Illinois and northward into Wisconsin, Michigan, and Minnesota. Variation was found to occur also in the tarsal claws. Specimens from the vicinity of Lake Marion, Fla., showed these structures to be less appendiculate.

Discussion: *L. ater* (Haldeman, 1849) and *L. viridanus* (Fall, 1927), are synonymized and the types of both (Museum of Comparative Zoology) have been seen by the author. These two descriptions, it now appears, were applied to forms not exactly like the type *L. saponatus*, but are, nevertheless, conspecific. Wilcox (1956) and M. W. Sanderson (personal communication) also indicated possible new species which I believe are also variations. *Cryptocephalus saponatus* Fabricius is the oldest name to apply to this species. *L. ater* was described by Haldeman in 1849. After this name, Haldeman (1849) credited Knoch (1801) for its origin in the genus *Clytra;* however, Knoch's name was "uncharacterized." F. V. Melsheimer (1806) in the first separate publication in America referring to insects, also credits Knoch for the name. But Melsheimer's catalogue (1806)

neither describes nor "characterizes" its names. In it, *L. ater* is listed as a synonym of "*Indicus* Knoch" in the genus *Cryptocephalus*.

Male genitalia: Apparently the only published illustrations of this structure appear in Powell (1941). The length of the adeagus is 0.70 mm. long; its width is 0.28 mm. It is larger than that of the other species and gives the impression of relative compactness. The portion of the ventral apical lobe beyond the dorsal plate is less than half the width of the aedeagus at the median orifice. Twenty specimens were dissected.

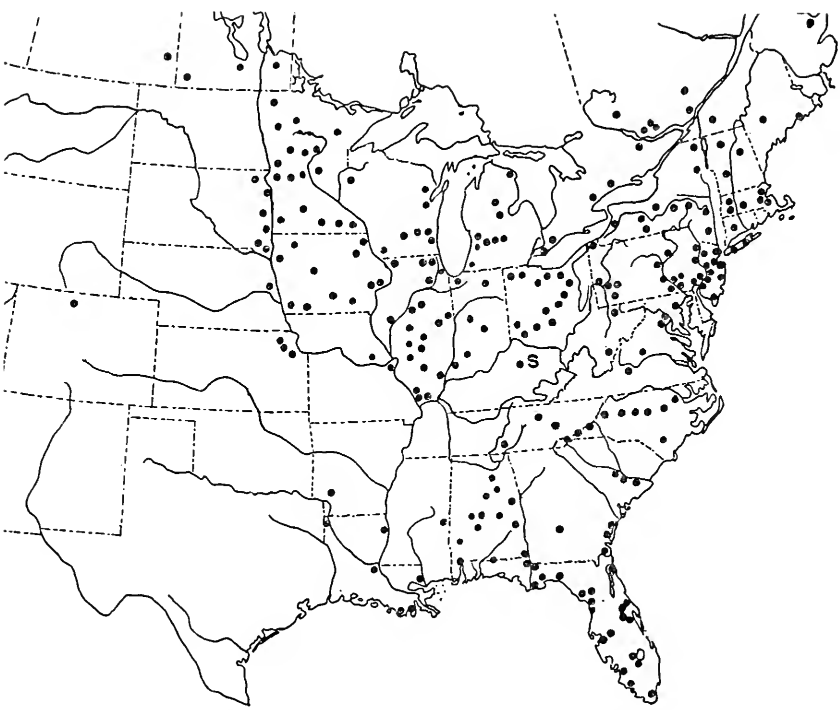


FIGURE 3.—Geographic distribution of *Lexiphanes saponatus* (Fabricius). S=state locality.

Female genitalia: No published illustrations of the spermatheca were found. This structure is much larger than that of any other Nearctic species. Twenty-one specimens were dissected.

Biology: The following data accompanied the specimens: From *Salix candida*, Onah, Man., Canada, July 12; *Solidago*, Sherborn, Mass., Aug. 10, Wilbraham, Mass., June 4; *Desmodium*, W. Springfield, Mass., July 15; sweeping knotweed, Litchfield, Conn., Aug. 21; on willow, Orient, L.I., N.Y., July 5; *Oenothera* species, Harrisburg (Wildwood Park), Pa., July 4, Aug. 14; on Queen Ann's Lace, Heckton Mills, Pa., Aug. 19; on *Eupatorium purpureum*, Heckton Mills,

Pa., July 20; on *Eupatorium purpureum*, Wildwood Pk., Harrisburg, Pa., Aug. 5, 27; Sumac, Dauphin, Pa., July 4; on elm, Westfield, N.J., June 18; sweeping *Solidago*, Solomon I[sland], Md., July 11; on *Oenothera*, Occoquan, Va., June 6; on *Veronica*, Dawson's Beach, Occoquan, Va., June 6; willow, Cherry Point, N.C., June 3; *Polygonum hydropiperoides*, Levy Co., Fla., Sept. 10, 13; St. John's, Wort (*Hypericum* species) 3 mi. SW. Lake Marion, Fla., Mar. 15; Rosemary species (*Rosmarinus officinalis L.*) 3 mi. SW. Lake Marion, Fla., Mar. 15; taken on *Sambucus canadensis*, Meadows Mill, Lee Co., Ala., June 14, and Tuskegee Nat. For., Macon Co., Ala., June 25; taken on *Cephalanthus occidentalis*, 3.5 mi. NW. of Chehaw, Macon Co., Ala.; taken on *Eupatorium purpureum*, Sand Springs., Macon Co., Ala., June 21; sedge, Oak Ridge, AEC area, Tenn., July 4; Bidens, Volo, Volo Bay, Ill., June 16; swept from *Melilotus*, Iowa, July 13; collected from Forest Floor, Washington Co., Wis.; light trap, Crookston, Minn., July 12.

Records in the literature recording possible hosts were found in Weiss and West (1921): "*Monachus ater* Hald. Monmouth Jc., N.J. July 14 on leaves of *Apocynum androsaemifolium* L." and in Blatchley (1910): "Occurs on foliage of milkweed and other herbs."

Attempts at rearing adults of this species in the laboratory on *Eupatorium purpureum* were not successful.

Type: This specimen was noted to be in the Bosc collection according to Fabricius when he described the species. Mrs. Doris H. Blake of the U.S. National Museum informed the author (pers. comm.) that this specimen was not there when she viewed two boxes of Bosc material in Paris in 1950 (see also Blake, 1952). This specimen was likewise not found among the Fabrician types in the Universitetes Zoologiske Museum, Copenhagen, Denmark (S. L. Tuxen, pers. comm.). Neither was the type distinguished from among Suffrian material loaned by J. O. Hüsing, Martin Luther Universität, Halle-Saale, East Germany. As Fabricius' type may one day be found, and no current dilemma results without it, a neotype was not designated.

Type locality: "Habitat in Carolina" (Fabricuis, 1801). As the type was to have been in the Bosc collection it was most likely collected by him at or near the Michaux gardens at Charleston, S.C. (Blake, 1952).

Distribution: Collections of this species have been made in the eastern United States and Canada westward to about the 100th meridian. Specimens totaling 2174 were examined from the following localities:

CANADA: Alberta: Walsh, "Ont." [probably Alberta]. Manitoba: Aweme; Delta; Douglas Lake, Aug. 30; Rennie, June 3. New Brunswick: Bathurst, July 7; Sackville, July 6. Nova Scotia: Castlereigh. Ontario:

Britania; Grand Bend; Leamington, May 11, Sept. 1; Pelee Island; Point Pelee; Prince Edward Co.; Scotia Jct.; Toronto; Turkey Pt. QUEBEC: Covey Hill; Forestville, "Ont." [probably Quebec], June 16; Hull, Aug. 8; Knowlton; Montreal Isl.; Petton Springs; Rigaud; St. Johns.

UNITED STATES: ALABAMA: AUTAUGA CO.: 6.7 mi. W. of Prattville. BARBOUR CO.: Eufaula. CHOCTAW CO.: Bladon Spgs. St. Pk. CLAY CO.: Pyriton. COVINGTON CO.: Florala, May 23. DALLAS CO.: Blue Girth Creek. HOUSTON CO.: Chattahoochee St. Pk. LEE CO.: Auburn, Oct. 20; Meadows Mill; 1 mi. E. of U.S. 29, Chewacla Crk. LOWONES CO.: 1.3 mi. SW. of Hayneville. MACON CO.: 3.5 mi. NW. of Chehaw; Sand Springs; Tuskegee Nat. For. MARSHALL CO.: 1.5 mi. W. of Horton; 3.2 mi. S. of Martling. MOBILE CO.: Mobile. TALLADEGA CO.: Sylacauga. UNKNOWN LOCALITY: "Coleta."

ARKANSAS: HEMPSTEAD CO.: Hope, July 19.

COLORADO: LARIMER CO.: Ft. Collins [possibly mislabled], June.

CONNECTICUT: FAIRFIELD CO.: Stanford. LITCHFIELD CO.: Georgetown C.

DISTRICT OF COLUMBIA: Bennings, Licking Banks, June 7; Oxon Run, Washington; Pimmit River; Rock Pile; Washington; Oct. 6.

GEORGIA: CHARLTON CO.: Okefenokee Swamp. CHATHAM CO.: Savannah, May 27, Oct. 18; Tybee Island. GLYNN CO.: Camp Stewart. TIFT CO.: Tifton. UNKNOWN LOCALITY: Bull Island.

ILLINOIS: BOND CO.: Greensville. CARROLL CO.: Champaign; Tolona; Urbana. CLINTON CO.: Carlyle. COOK CO.: Chicago, Melrose Pk. FORD CO.: 9–11 mi. N. Piper City. FULTON CO.: Forest City. IROQUOIS CO.: 3 mi. E. Watseka. JACKSON CO.: Carbondale; Grand Tower. JO DAVIESS CO.: E. Dubuque. LAKE CO.: Beach, Wauconda, Waukegan, Zion. LA SALLE CO.: Ottawa. MCHENRY CO.: Algonquin, Fox Lake. MCKEAN CO.: Bloomington. MACON CO.: Warrensburg. MARION CO.: Kinmundy, Sandoval, SW. Kinmundy, Peoria. POPE CO.: Golconda. PUTNAM CO.: no further data. ROCK ISLAND CO.: Rock Island. SANGAMON CO.: Springfield. VERMILION CO.: Jan. 27, no further data. LOCALITIES NOT PLACED TO COUNTY: Bell Smith Spgs.; Browns; Chestnut; DuBois; Equality; Farina, Gladstone; Giant City St. Pk.; Magnolia; Makauda; Muncie; NE. Beaverville; Olive Branch; Orland St. Pk.; Patoka (5 mi. S. on highway); Spring Bay Region; Sta. 42 Dupo, May 14; Sun Lake Bog; Utica; Villa Ridge; Vivay Park; Volo, Tamarack Bog; Volo, Volo Bay; White Heath; Wolf Lake.

INDIANA: FOUNTAIN CO.: Sept. 1, no further data. GREEN CO.: Mineral Spgs. KOSCIUSKO CO.: Winona Lake. LAKE CO.: May 5, no further data; Gibson. MARION CO.: no further data. TIPPECANOE CO.: Lafayette. LOCALITIES NOT PLACED TO COUNTIES: Ind., no further data; L. George.

IOWA: ALLAMAKEE CO.: no further data. BOONE CO.: Boone. Dickinson Co. (Co. #3): no further data. FAYETTE CO.: Clermont. FREMONT CO.: Riverton. JOHNSON CO.: Iowa City, June 12; Solon, Aug. 22. LUCAS CO.: Charlton. SCOTT CO.: Pleasant Valley. TAYLOR CO.: Gravity. WAPELLO CO.: Eddyville. WOODBURG CO.: Sioux City.

KANSAS: DOUGLAS CO.: no further data. MONTGOMERY CO.: Elk City, May 23. POTTAWATOMIE CO.: Onaga. RILEY CO.: July. SHAWNEE CO.: Topeka.

KENTUCKY: no further data.

LOUISIANA: CADDO PAR.: Aug. 19. JEFFERSON PAR.: Harahan. MADISON PAR.: Tullulah. ORLEANS PAR.: New Orleans. ST. LANDRY PAR.: Opelousas. ST. MARY PAR.: Franklin, Morgan City. ST. TAMMANY PAR.: Pearl River, Apr. 6.

MAINE: FRANKLIN CO.: Weld. HANOCK CO.: Mount Dessert Isle, Aug. 14. LOCALITIES NOT PLACED TO COUNTY: Paris; Wales, June 23.

MARYLAND: BALTIMORE CO.: Sparrows Point. BALTIMORE CITY CO.: Baltimore. CALVERT CO.: Chesapeake Beach, Solomon Is. KENT CO.: Chestertown. MONTGOMERY CO.: Aug. 23; Cabin John; Cabin John Bridge; Glen Echo. PRINCE GEORGES CO.: Bladensburg, Riverdale. LOCALITIES NOT PLACED TO COUNTIES: Breton Bay, Potomac River; Hills Bridge, Patuxent River; Lakeland; Near Plummers Island; Opposite Plummers Island; Plummers Island, May 28.

MASSACHUSETTS: BRISTOL CO.: Tauton. HAMPTON CO.: Chicopee; Holyoke; Springfield; W. Springfield; Wilbraham. HAMPSHIRE CO.: S. Amhurst. MIDDLESEX CO.: Bedford; Framingham; Holliston; Lexington; Sherbon; Stoneham, Wayland. NORFOLK CO.: Canton; Franklin. WORCESTER CO.: Berlin, Sept. 9. LOCALITIES NOT PLACED TO COUNTIES: Blue Hill, Apr. 28; Montgomery; Mt. Wachusett.

MICHIGAN: Aug. 24. ALLEGAN CO.: Douglas Lake. BAY CO.: no further data. BERRIEN CO.: Sodus. CALHOUN CO.: Wise Lake. CHEBOYGAN CO.: no further data. CLARE CO.: no further data. EATON CO.: Gd. Ledge. KALAMAZOO CO.: Galesburg, Apr. 15. MISSAUKEE CO.: Lake City. VAN BUREN CO.: Gobles, Gr. Junction. WAYNE CO.: Detroit. LOCALITIES NOT PLACED TO COUNTIES: Block Lake, Toledo Beach.

MINNESOTA: ANOKA CO.: More's Lake. BIG STONE CO.: Barry. CHICAGO CO.: no further data. CLEARWATER CO.: no further data. CROW WING CO.: no further data. HENNEPIN CO.: Crystal Lake; Lake Calhoun; Minneapolis; St. Anthony Park, June 5; St. Louis Park. ITASCA CO.: Ball Club, Ball Club Rnep; Deer River; Itasca Park. KANDIZOHI CO.: Wilmar; Eagle Lake. LE SUEUR CO.: Waterville. MARSHALL CO.: Viking. MILLE LACS CO.: Princeton. NICOLLET CO.: St. Peter Fish Hatchery, Aug. 18. OLMSTED CO.: No further data. OTTER TAIL CO.: Fergus Falls. PINE CO.: Willow River. PIPESTONE CO.: no further data. POLK CO.: Crookston. POPE CO.: Sedan. RAMSEY CO.: Lake Owasa; Mid Hills Golf Club; New Brighton; St. Paul; St. Paul U. Farm; White Bear. SCOTT CO.: Blakely, Savage; Shakopee. STEELE CO.: Owstonna. STEVENS CO.: Morris. TODD CO.: Eagle Bend. TRAVERSE CO.: no further data. WASHINGTON CO.: no further data. WINNONA CO.: Kings Bluff. WRIGHT CO.: Howard Lake. LOCALITIES NOT PLACED TO COUNTIES: Elk River; Ft. Snelling; Lake Minnetonka; Little Canada.

MISSISSIPPI: GREENE CO.: Leakesville, May 23. LAUDERDALE CO.: Meridian. LOCALITY NOT PLACED TO COUNTY: Van Cleave, June 24.

MISSOURI: CALLAWAY CO.: Fulton. CENTRAL MISSOURI; Aug., no further data. St. Louis (independent city). ST. LOUIS CO.: Creve Coeur Lake, June 10.

NEBRASKA: DOUGLAS CO.: Omaha, June 15, June 27.

NEW HAMPSHIRE: GRATON CO.: Franconia. LOCALITIES NOT PLACED TO COUNTIES: Mt. Plst. Hse., July 5; Mt. Washington; Randolph, July 2.

NEW JERSEY: BERGEN CO.: Englewood, Fairlawn, Ramsey, Westwood. BURLINGTON CO.: Pemberton, Riverton. CAMDEN CO.: Camden, Clementon, Gloucester; Merchantville. CAPE MAY CO.: Cape May, Tuckahoe. GLOUCESTER CO.: Malaga, May 30; Westville; Woodbury. MIDDLESEX CO.: Jamesburg, Aug. 16; Milltown; N. Brunswick; S. River. MORRIS CO.: Boonton, Budds Lake; Chester. OCEAN CO.: Barnegat Bay. UNION CO.: Westfield. WARREN CO.: Phillipsburg.

NEW YORK: ALBANY CO.: Albany. CHEMUG CO.: Elmira, June 18. CHESTER CO.: no further data. CLINTON CO.: Redford. ERIE CO.: Hamburg. ESSEX CO.: Heart Lake, Aug. 25. GREENE CO.: Slide Mt., Catskill. KINGS CO.: Brooklyn. NEW YORK CO.: New York City. ONODAGO CO.: no further

data. ORANGE CO.: West Point. OSWEGO CO.: St. Mary's Pond. RICHMOND CO.: Statten Island. ROCKLAND CO.: no further data. SCHENECTADY CO.: Schenectady. SUFFOLK CO.: Montauk. TOMPKINS CO.: Ithaca. WARREN CO.: Avalanch Lake, Adirondacks. LOCALITIES NOT PLACED TO COUNTIES: Aqueduct, Cedar River; Golden; Hastings; Ogdensburg; Orient; Potsdam; Underwood; Van Courtland Park.

NORTH CAROLINA: AVERY CO.: Linville, 3500 ft. BUNCOMB CO.: Blue Ridge Pkwy., 4000 ft.; Swannanoa Val.; Valley of Black Mts. CARTERET CO.: Beaufort. CHEROKEE CO.: Murphy. EDGECOMB CO.: Rocky Mount. MACON CO.: Franklin, 2000 ft. MITCHELL CO.: no further data. RANDOLPH CO. Pisgah, Aug. 30. ROBESON CO.: Lumberton. WAKE CO.: no further data. LOCALITIES NOT PLACED TO COUNTIES: Auburn, Cherry Point, Morrow Mtn. State Park, Mulberry Gap.

OHIO: BUTLER CO.: Oxford. ERIE CO.: Castalia. FRANKLIN CO.: no further data. FULTON CO.: Wauseon. HAMILTON CO. Cincinnata. HOCKING CO.: no further data. LICKING CO.: Buckeye Lake. LORAIN CO.: no further data. MADISON CO.: London. SANDUSKY CO.: Cedar Pt., Sept. 8. SUMMIT CO.: Kent. WAYNE CO.: Wooster. WILLIAMS CO.: June 14, no further data. LOCALITIES NOT PLACED TO COUNTIES: Bay Point, Jersey.

PENNSYLVANIA: ALLEGHENY CO.: Glenn; Pittsburgh, June 6. BEAVER CO.: New Galilee; Rochester. BUCKS CO.: Mechanicsville; Uhlerstown. CENTER CO.: Philipsburg. CUMBERLAND CO.: 2 mi. SW. Mount Holly Springs, New Cumberland. DAUPHIN CO.: Dauphin; Fishing Creek Valley; Harrisburg; Harrisburg (Wildwood Park): Linglestown. DELAWARE CO.: Castel Rock; Glen Olden. ERIE CO.: Presque Isle; Waldemeer. FAYETTE CO.: Ohiopyle, Aug. 10. JEFFERSON CO.: Westville. LANCASTER CO.: Colemanville, Penryn. LEBANON CO.: Mount Gretna. LYCOMING CO.: Cedar Run. MONROE CO.: Pocono Lake, Water Gap. MONTGOMERY CO.: Abington, Glenside, Miquon. NORTHAMPTON CO.: Easton, Lehigh Gap, Wind Gap. PERRY CO.; Cove Mt., Drumgold. PHILADELPHIA CO.: Angora, Mt. Airy Sta., Philadelphia Neck. WESTMORELAND CO.: Jeannette. YORK CO.: Hanover.

RHODE ISLAND: WASHINGTON CO.: Watch Hill, July 11.

SOUTH CAROLINA: BEAUFORT CO.: Hardeeville. DORCHESTER CO.: Pregnall. LEXINGTON CO.: Swansea, Aug. 11. OCONEE CO.: Mountain Rest, June 6. ORANGEBURG CO.: Holly Hill. "Carolina" (Suffrian material): 29560, 34433, 34434, 29559, 29557, 18713, 29556, 29558, 19506.

SOUTH DAKOTA: BROOKINGS CO.: Brookings, July 25; White. CLAY CO.: Vermillion, June 11. DAY CO.: Waubay. DEVEL CO.: Clear Lake. LAKE CO.: Chester. UNION CO.: Beresford, Elk Point.

TENNESSEE: ANDERSON CO.: Oak Ridge, AEC area. LAWRENCE CO.: Lawrenceburg, Aug. 4. SEVIER CO.: Great Smoky Mt. Nat. Pk., June 14. SMITH CO.: Elmwood. LOCALITY NOT PLACED TO COUNTY: Crabtree.

VERMONT: ORLEANS CO.: Lake Willoughby, 1200 ft., June 17. WINDSOR CO.: Norwich.

VIRGINIA: ALEX. CO. [sic, probably in vicinity of Alexandria]. ARLINGTON CO.: Arlington; Rosslyn; Great Falls, "Md."; Chain Bridge. FAIRFAX CO.: Clifton. LOUDOUN CO.: Sept. 22. NELSON CO.: no data. PRINCE WILLIAM CO.: Dawson's Beach, Occoquan; Occoquan. SPOTSYLVANIA CO.: Fredericksburg. LOCALITIES NOT PLACED TO COUNTIES: Black Pond; Four Mile Run, May 31; Great Falls.

WISCONSIN: DANE CO.: Madison. DODGE CO.: Beaver Dam. GRANT CO.: Boscobel, June 14. MILWAUKEE CO.: Milwaukee. POLK CO.: Amery, Aug. 13. SHAWANO CO.: Shawano. WASHINGTON CO.: West Bend.

Lexiphanes affinis (Haldeman, 1849), new combination

FIGURES 4, 13, 18

Monachus affinis Haldeman, 1849, p. 264. [Page precedence over *M. auritus* Haldeman.]
Monachus auritus Haldeman, 1849, p. 264.
Monachus thoracica [*us*] Crotch, 1873, p. 31. [New synonymy.]
Monachulus auritus (Haldeman), Leng, 1920, p. 290 (checklist).
Monachulus thoracicus (Crotch), Leng, 1920, p. 290 (checklist).

Diagnostic description: Color piceous or black, the following yellowish red: head, antennae, mouth parts, prothorax, and legs. Shape oval, similar to *L. seminulum*, but more robust, especially the pronotum. Elytra with deeply impressed submarginal striae and distinct punctations. Female with a callus on either side of the fovea on the last ventral abdominal segment. Male with punctures on the last ventral abdominal segment.

Variation: The observed size range, in millimeters, is 1.65 long by 1.25 wide to 2.23 long by 1.67 wide. Color variation is quite common in this species, the prothorax and legs ranging from completely yellowish red (this is the form most commonly collected) to completely dark. Along the basal line of the pronotum, at times a few punctuations can be noticed, but the species is primarily devoid of the punctures at this location.

Discussion: Haldeman (1849) designated as type an intergrade specimen with a bicolored pronotum. Crotch (1873) correctly synonymized Haldeman's two species (*L. auritus* with *L. affinis*) but believed the latter to be the sexually dimorphic female. He further described *L. thoracica* [*us*], a form with the pronotum largely yellowish red. In 1885, Henshaw reversed the order of Crotch's synonymy, making *L. affinis* a variety of *L. auritus*. Leng (1920) continued this synonymy. (Holotypes and syntypes of the above species were examined in the Museum of Comparative Zoology, Harvard College.) Chevrolat (1837) included *L. thoracicus* Dejean in his newly established genus, but it appears that the Dejean name was a nomen nudum.

Male genitalia: The length of the aedeagus is 0.67 mm. and its width is 0.24 mm. It is narrow in comparison to its length. The ventral apical lobe is broad and scoop shaped and the lateral lobes taper gradually in comparison to those of *L. seminulum*, which also rise much higher. Ten specimens were dissected.

Female genitalia: The spermatheca is of average size. It is nearly uniformly thick and almost forms a right angle. The free end is rounded and not pointed as in *L. seminulum*. One specimen was dissected.

Biology: The following data were observed on labels: beating wax myrtle, Deep Creek, Va., July 17; *Rhus copallina*, Morrow Mountain State Park, N.C.; Wild Plum, Saluda Co., S.C., Aug. 18; taken on *Sambucus canadensis*, Meadows' Mill, Lee Co., Ala., June 14, 1963; taken on *Onagra* with one *L. seminulum*, W. B. Bankhead Nat. For., Nat. Bridge Rec. Area, Winston Co., Ala., June 27, 1963.

Type: Female, "Type 8399" (LeConte collection, Museum Comparative Zoology). The type specimen exhibited some punctations along the pronotal basal line.

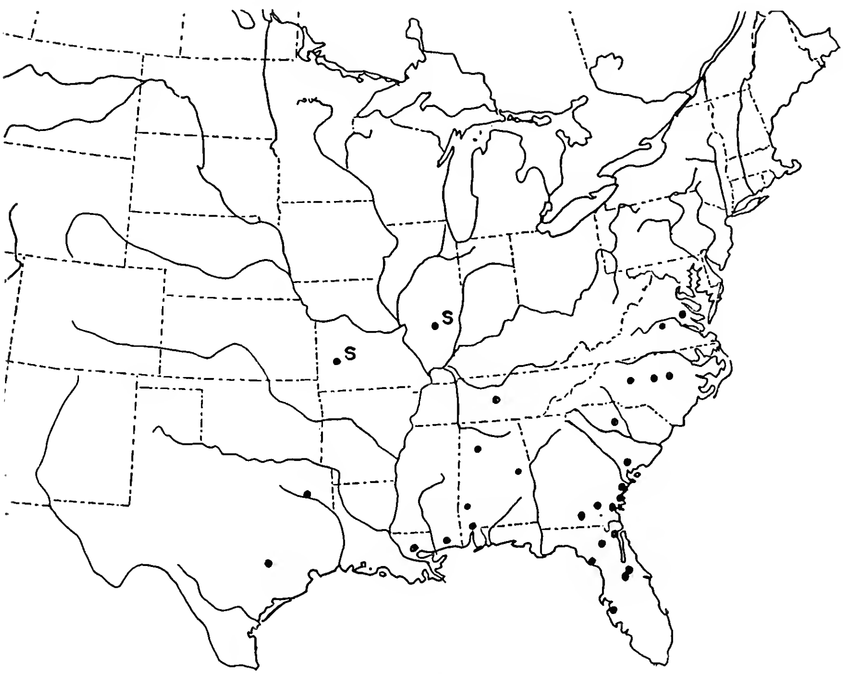


FIGURE 4.—Geographic distribution of *Lexiphanes affinis* (Haldeman). S=state locality.

Type locality: "Southern. (Southeastern United States)" (Haldeman, 1849). This is further indicated by the orange paper disc on the type pin, which means southern United States in LeConte's color key.

Distribution: The species occurs in southeastern United States, west to Texas and north to Virginia and Illinois. Ninety specimens were examined from the following localities:

ALABAMA: CHOCTAW CO.: Bladon Springs, Aug. 1. MOBILE CO.: Mobile, June 14. WINSTON CO.: W. B. Bankhead Nat. For., Nat. Bridge Rec. Area.

FLORIDA: ALACHUA CO.: Aug. 6, no further data. DUVAL CO.: Jacksonville. LEE CO.: Estero, June 12. LEVY CO.: Cedar Keys; Yankeetown. OSCEOLA CO.: Kissimmee. VOLUSIA CO.: Enterprise.

GEORGIA: CHATHAM CO.: Savannah, June 14; Tybee Island. GLYNN CO.: St. Simons Island. WARE CO.: Waycross, July 18.

ILLINOIS: no further data.

LOUISIANA: ST. TAMMANY PAR.: Pearl River, June 4.

MISSISSIPPI: GEORGE CO.: Lucedale, June 17. NORTH JACKSON CO.: Aug. 23.

MISSOURI: Western Missouri, no further data.

NORTH CAROLINA: EDGECOMB CO.: Rocky Mount, Aug. 27. LOCALITY NOT PLACED TO COUNTY: Morrow Mtn. State Park, July 21.

SOUTH CAROLINA: BEAUFORT CO.: Yemasee, June 14. SALUDA CO.: Aug. 18.

TENNESSEE: DAVIDSON CO.: Nashville, June 14.

TEXAS: COLORADO CO.: Columbus, Apr. 6.

VIRGINIA: AMELIA OR NOTTOWAY COS.: Deep Creek, July 17. PRINCESS ANNE CO.: Virginia Beach, July 17.

Lexiphanes seminulum (Suffrian, 1858)

FIGURES 5, 14, 19

Monachus seminulum Suffrian, 1858, p. 344.
Lexiphanes seminulum (Suffrian, 1858). [Resurrected here from synonymy with *Lexiphanes guerini* (Perbosc, 1839).]

Diagnostic description: Color piceous, the tarsi, first three antennal segments, clypeus, and labial palpi tawny. Shape oval, similar to *L. affinis*, but with the pronotum slightly less robust. Pronotum dull and rugulose, with sparse, fine, obsolescent punctules and a basal row of punctures in most cases. Elytra with deeply impressed submarginal striations and distinct punctures. Elytral epipleuron with one row of punctures. Body essentially glabrous and shinning (not metallic). Scutellum triangular, with especially straight edges. Antennae with first segment broader and more than twice as long as second, the third and fourth segments shortest, segments five through eleven broader and more setose. Prosternum and mesosternum rugose. Metasternum finely rugulose and with punctures bearing short setae. First ventral abdominal segment of male rugose between the coxal cavities. Fifth ventral abdominal segment of female with a broad fovea and short setae on either side of it.

Variation: The observed size range, in millimeters, is 1.58 long by 1.17 wide to 2.25 long by 1.50 wide. The average size is 2.00 long by 1.33 wide. This species averages smaller than *L. affinis*, but size ranges overlap so that this distinction is not valid. The general body color in some specimens varies from brownish black to piceous with the slightest hint of deep blue. The last ventral abdominal segment of some specimens is slightly tawny. The appendages vary from light tawny to brown. The distal ends of some of the tibae are also tawny. The elytral punctation is not quite so deeply impressed as in *L. affinis* and some of the striae become effaced medially.

Discussion: *L. seminulum* is not a synonym of *L. guerini* Perbosc, as indicated in the catalogues of Clavareau (1913), Leng (1920), Leng and Mutchler (1933), Blackwelder (1939, 1946). Their synonymization with *L. guerini* occurred through misinterpretation of Henshaw's checklist (1885) in which *L. seminulum* is listed last, unnumbered, and spaced apart, under the genus *Monachus*. It appears that Henshaw

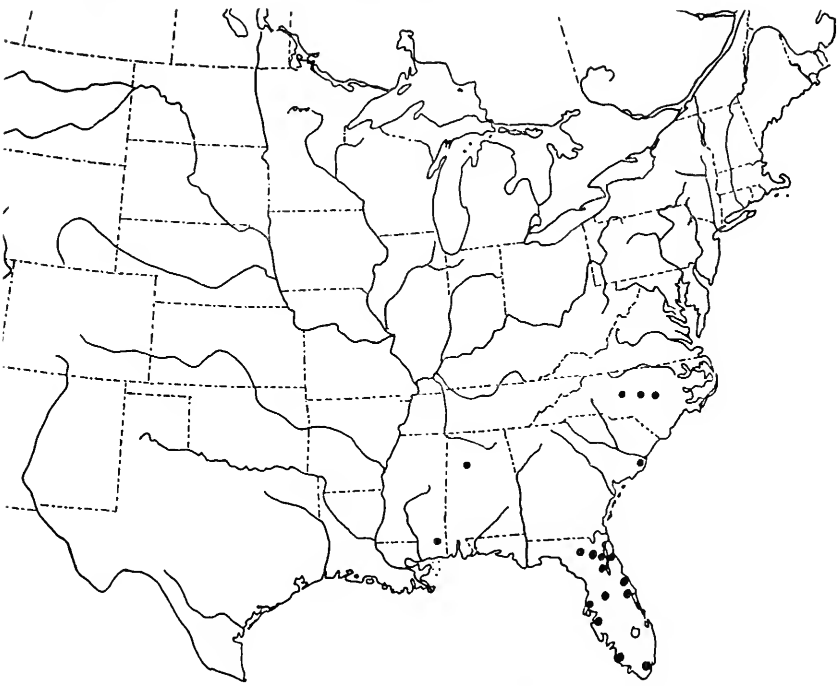


FIGURE 5.—Geographic distribution of *Lexiphanes seminulum* (Suffrian).

considered *L. seminulum* a species of uncertain value and position rather than a synonym of *L. guerini*. The distribution of *L. guerini*, being west of the Mississippi, (one specimen labled "D.C.," is believed to be a labeling error) further substantiates that these two allopatric species are not synonyms.

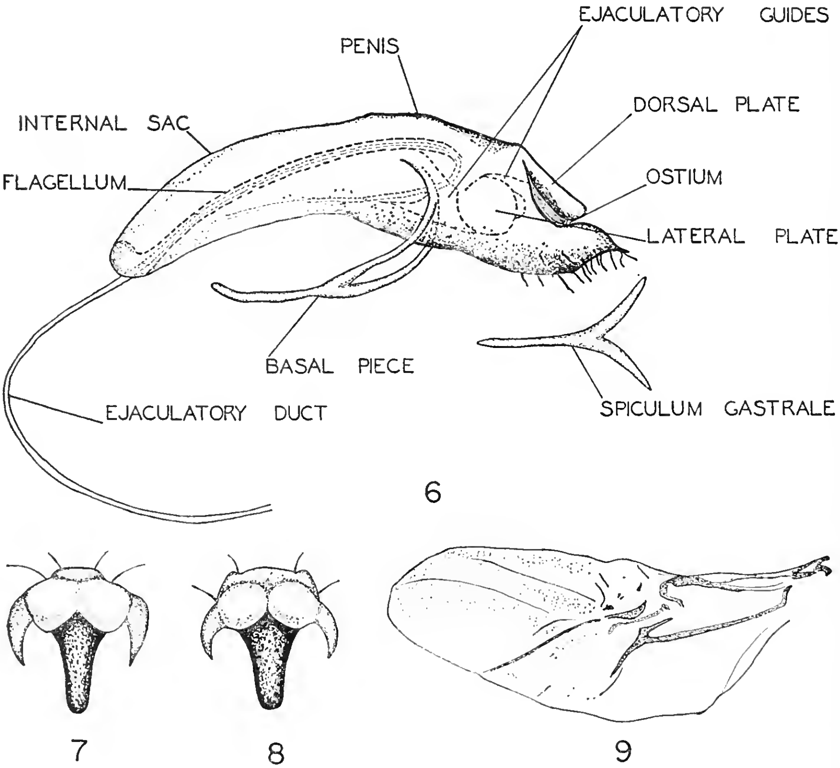
Male genitalia: The length of the aedeagus is 0.69 mm. and its width is 0.60 mm. The effect presented by the aedeagus is that of being long and slim. The dorsal edge of the lateral plates rises from the apex at an angle of about 35°. The ventral apical lobe tapers from its apex, where it is quite truncate. Ten specimens were dissected.

Female genitalia: The spermatheca is of average size. The free end tapers to a point. It also differs from *L. affinis* by being more acutely angled. Two specimens were dissected.

Biology: The following data were observed on specimen labels: on *Sassafras albidum,* Morrow Mountain State Park, N.C., July 20, 1959; in yellow pine area, Murrell's Inlet, S.C., May 10, 1948; oak, Interlachen, Fla., April 1951; taken on *Onagra* with one *L. affinis,* W. B. Bankhead Nat. For., Nat. Bridge Rec. Area, Winston Co., Ala., June 27, 1963.

Type: Male, "22469" (Suffrian collection, Martin Luther Universität, Halle-Saale, East Germany).

Type locality: "Aus Georgien" (Suffrian, 1858). The accompanying label, which is separate from the specimen pin, is of a green color and bears the following: "Seminulum m. Georgia." Dr. J. O. Hüsing of Martin Luther Universität informed the author that the labels which accompanied the Suffrian material were original with Suffrian.



Figures 6–9.—*Lexiphanes saponatus* (Fabricuis): 6, labeled male genitalia, left lateral view (spiculum gastrale, dorsal view), Wildwood Park, Harrisburg, Pa.; 7, fifth tarsal segment and distinctly appendiculate ungues of right hindtarsus, ventro-apical view, Lexington, Mass.; 8, fifth tarsal segment and nondistinctly appendiculate ungues of right hindtarsus, ventro-apical view, 3 mi. S. of Lake Marion, Fla.; 9, wing, Lake Calhoun, Hennepin Co., Minn.

Distribution: The range for this species extends within the southeastern United States from North Carolina west to Mississippi. Sixty-seven specimens were examined from the following localities:

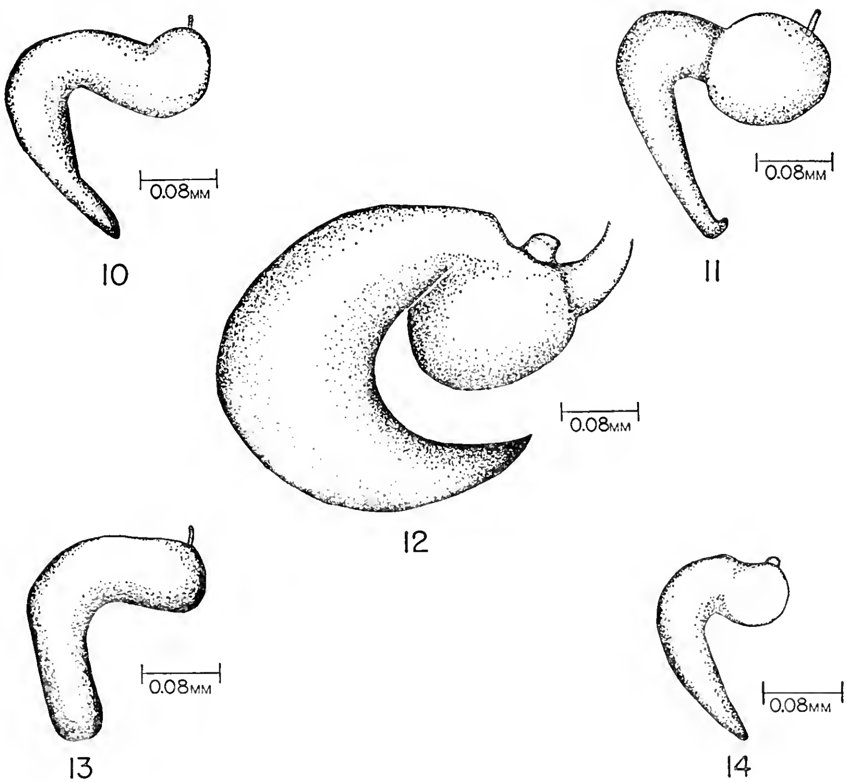
ALABAMA: LEE CO.: Meadows Mill. WINSTON CO.: W. B. Bankhead Nat. For., Nat. Bridge Rec. Area, June 27.

FLORIDA: ALUCHUA CO.: Gainesville, May 4. BREVARD CO.: Indian River. COLLIER CO.: Mar. 13. COLUMBIA CO.: O'Leno State Park, Aug. 29. DADE CO.: Biscayne, Oct. 5; Miami, Apr. 3. LAKE CO.: Nov. 1. MANATEE CO.: Bradenton, March. PINELLAS CO.: Bellair; Dunedin, May 14; Tarpon Springs, Mar. 2. PUTNAM CO.: Crescent City, May 23; Interlachen, Apr. 3. ST. JOHN'S CO.: St. Augustine, Apr. 2; Enterprise, May 19; Ormond; Sanford. LOCALITIES NOT PLACED TO COUNTY: Haulover, Mar. 17; Paradise Key, Feb. 21.

MISSISSIPPI: GEORGE CO.: Lucedale, Mar. 29–June 17.

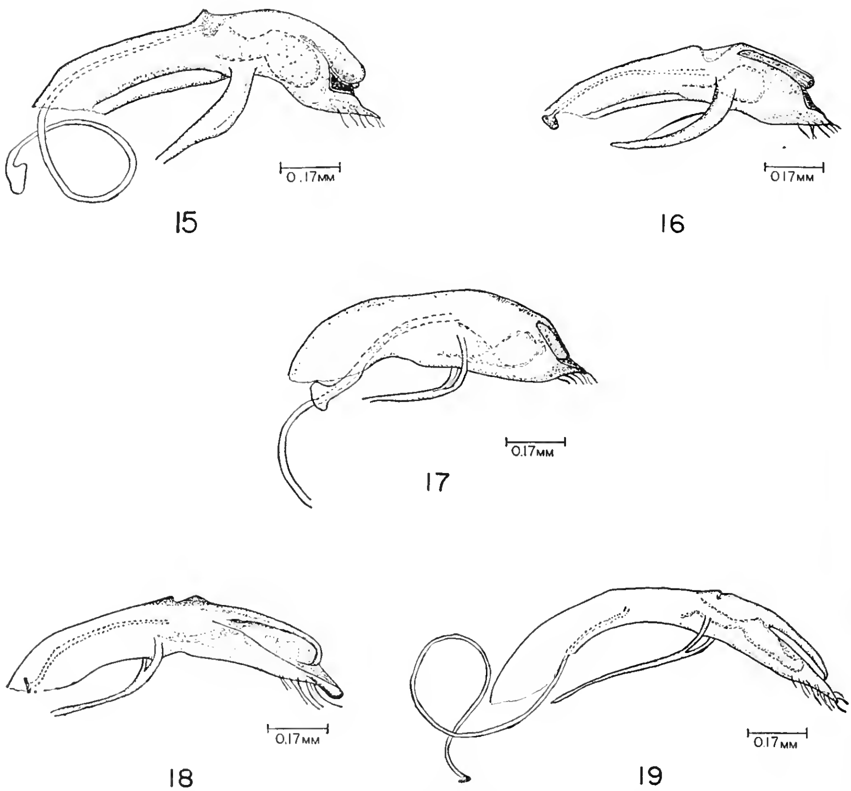
NORTH CAROLINA: WAKE CO.: Raleigh, June 15. LOCALITIES NOT PLACED TO COUNTY: Cherry Point, July 3; Morrow Mountain State Park, July 20.

SOUTH CAROLINA: GEORGETOWN CO.: Murrell's Inlet, May 10.



FIGURES 10–14.—Female spermatheca: 10, *Lexiphanes guerini* (Perbosc), Bill Williams Fork, Ariz.; 11, *L. mexicanus* (Jacoby), Dragoon Mts., Ariz.; 12, *L. saponatus* (Fabricius), La Salle Co., Ill.; 13, *L. affinis* (Haldeman), Tybee Island, Ga.; 14, *L. seminulum* (Suffrian), Enterprise, Fla.

Species removed from the genus: Three species that were included in this genus in catalogs are mentioned here for the sake of clarification. The first is *Monachus viridis* F. E. Melsheimer (1847). Melsheimer's type has not been studied but from his description, it seems to be synonymous with *Diachus auratus* (Fabricius, 1801). The first author of this synonymy is unknown to the writer, but this is shown in Leng (1920). The next two species were originally described under



FIGURES 15–19.—Male aedeagi: 15, *Lexiphanes guerini* (Perbosc) Bill Williams Fork, Ariz.; 16, *L. mexicanus* (Jacoby), C. Victoria, Tamaulipas, Mexico; 17, *L. saponatus* (Fabricius), Wildwood Park, Harrisburg, Pa.; 18, *L. affinis* (Haldeman), Saluda Co., S.C.; 19, *L. seminulum* (Suffrian), St. Augustine, Fla.

Clythra Fabricius: *nitidula* Fabricius (1801) and *punctulata* Fabricius (1801). These two species were listed under *Monachus* by Clavareau (1913). They also appeared in the Leng catalog (1920) as questionably occurring in the United States. Blackwelder (1946) lists them under *Clytra* Laicharting, a senior synonym of *Clythra* Fabricius, and reports them to occur only in South America. I have not seen specimens of these species; probably Blackwelder is correct in placing both in the genus *Clytra*.

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(New genera, species, etc., are printed in *italics*. Page numbers of principal entries also in *italics*.)

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